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FEBRUARY, 1938 CIRCULATION OF THIS ISSUE—IN EXCESS OF 14,000 COPIES 25c

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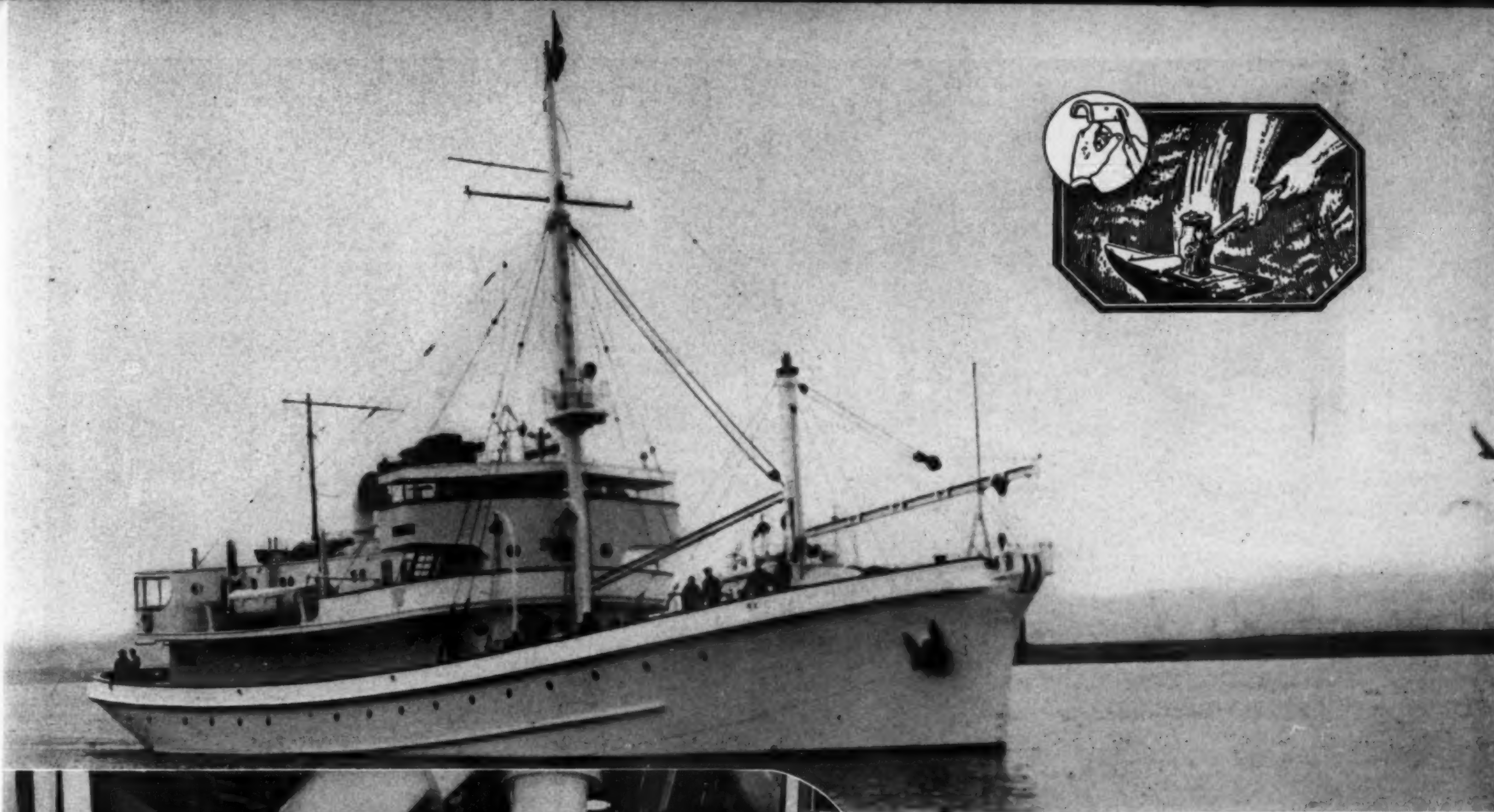

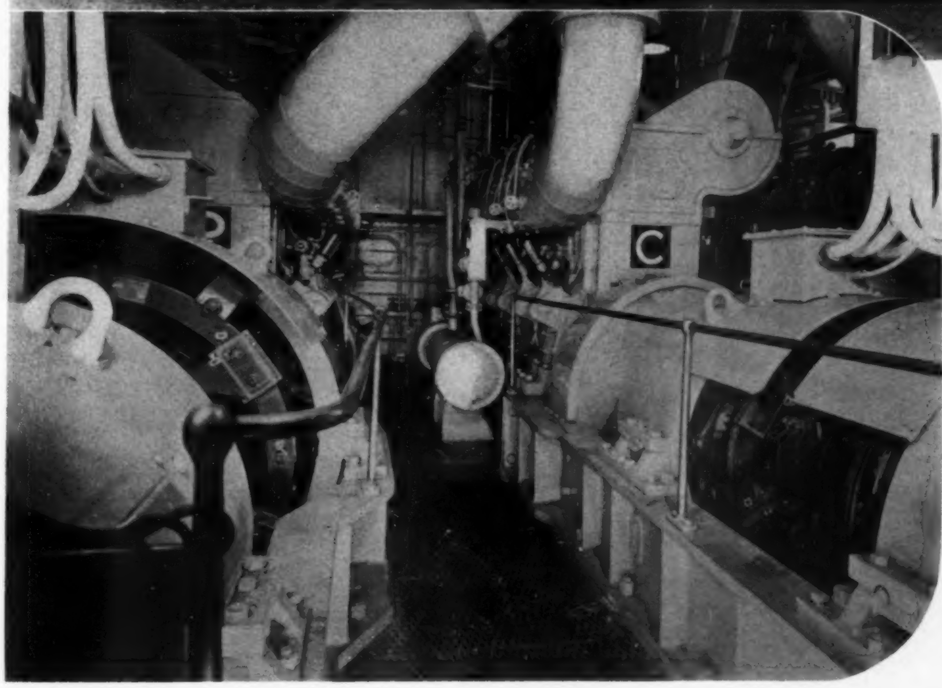

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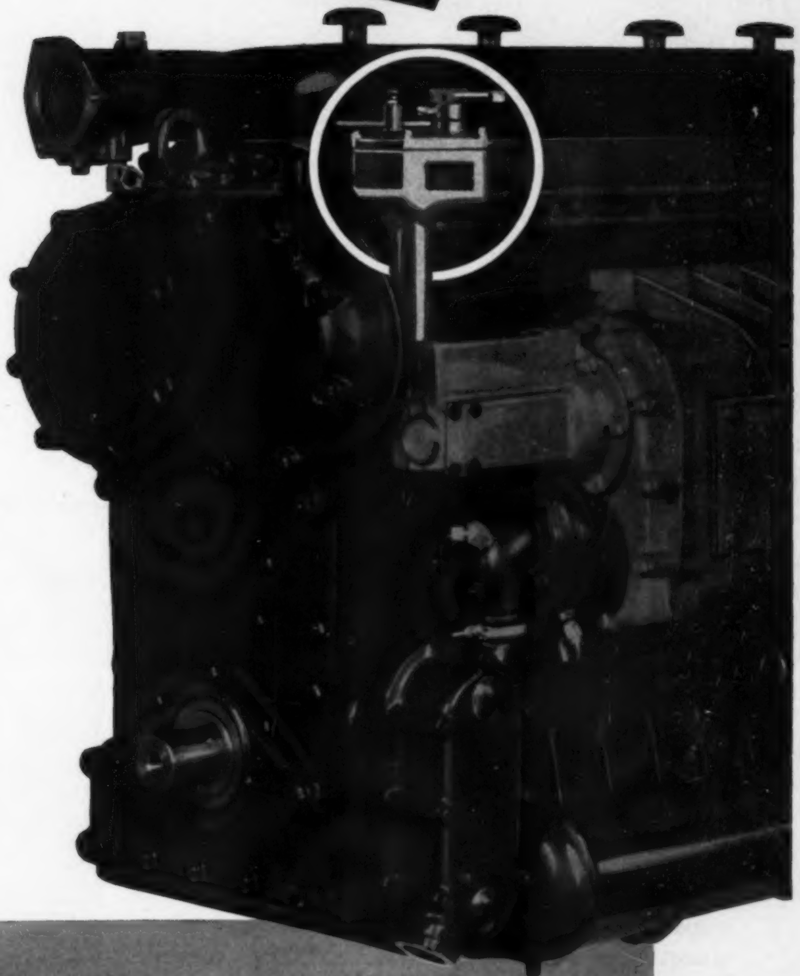

In this New

GENERAL MOTORS DIESEL

See Page 27 of this Issue

WE congratulate General Motors on this new G.M. Model 6-71, Six-cylinder, 2-cycle Diesel. And we congratulate Haulage, Industry and the whole power-consuming world on this significant addition to motive facilities which General Motors resources, research, and engineering have thus created and contributed to world welfare.

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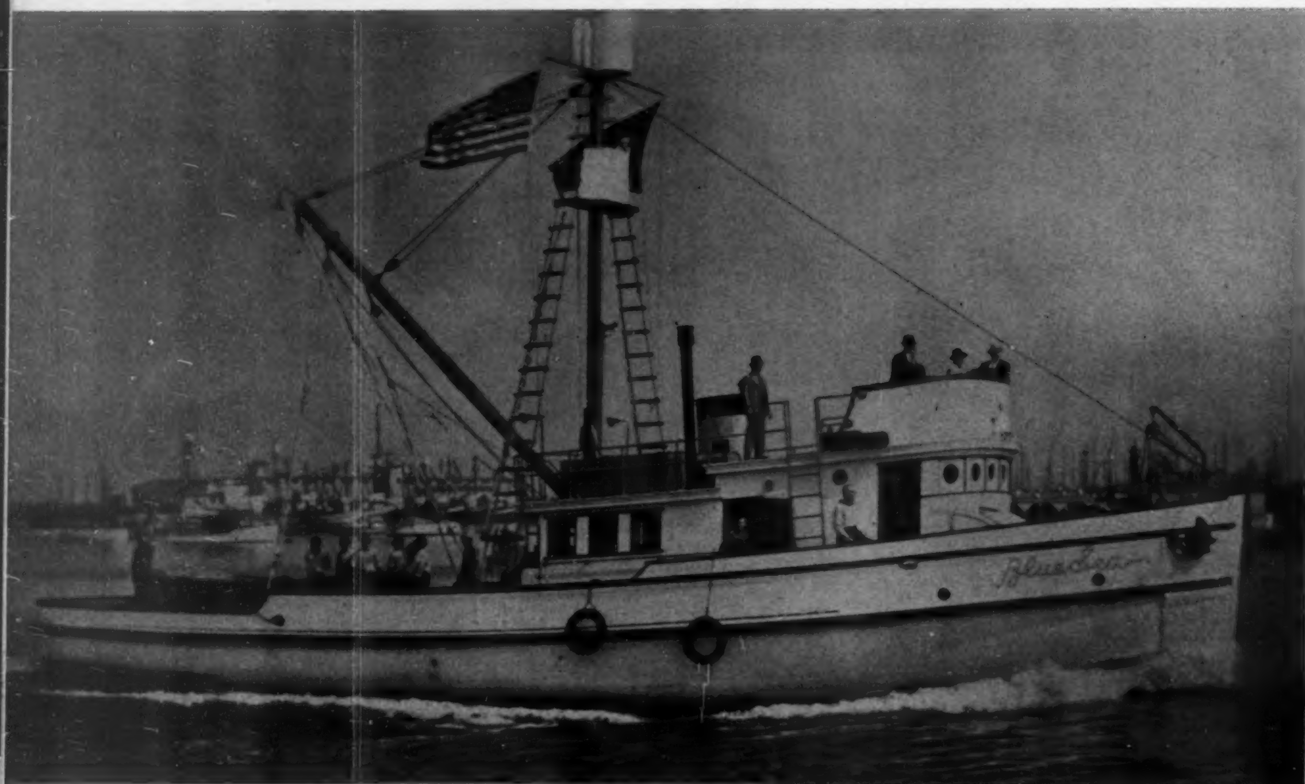

Close-up of Sentinel Model 7 Duplex filter as installed on the "Blue Sea"

A "SENTINEL" Guards the "BLUE SEA"

Strictly clean oil is of vital importance to owners and crews of the famous purse seiners. Each trip carries these vessels thousands of miles from port where profits and sometimes even lives depend upon the sturdy Diesels which power the great majority of this fleet.

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The purse seiner, "Blue Sea", owned by the Southern California Fish Corporation. On the wall to the left of the Cooper-Bessemer Diesel appears the Sentinel fuel oil filter.

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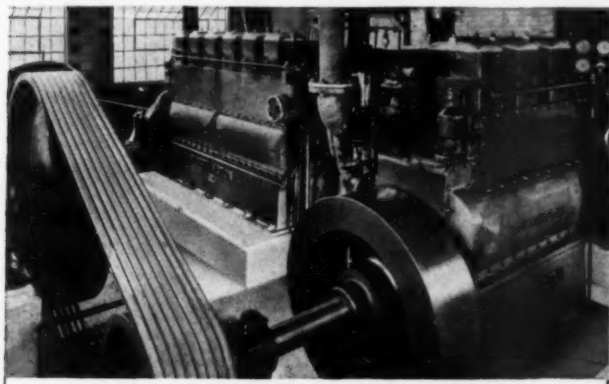
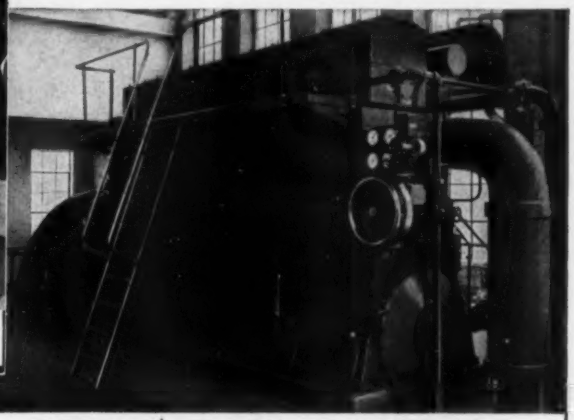


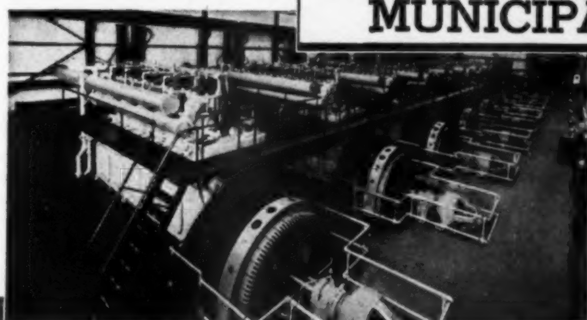
MANUFACTURING

Worthington 90-hp. and 180 hp. Diesels driving generator and compressor, through Worthington Multi-V-Drives, in metal products plant



MUNICIPAL POWER

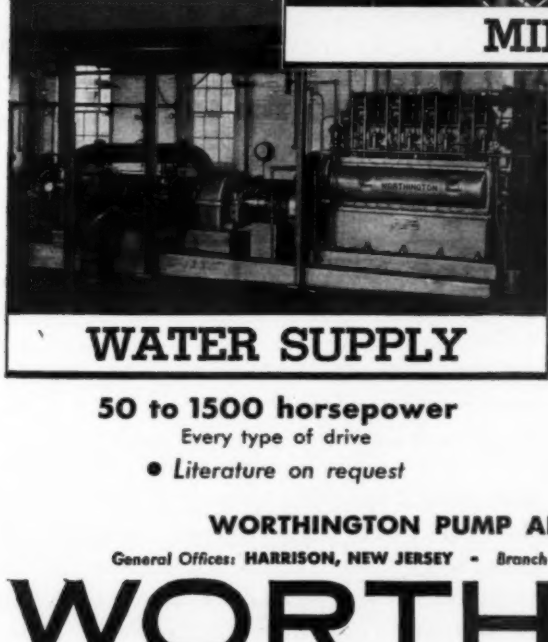
Worthington 750-hp. Diesel Engine direct-connected to generator in municipal plant



MINING

Eight Worthington 625-hp. Diesels on power generating service for mining operations

Worthington 100-hp. Diesel Engine driving two Worthington Centrifugal Pumps, in series, through speed-increasing gears



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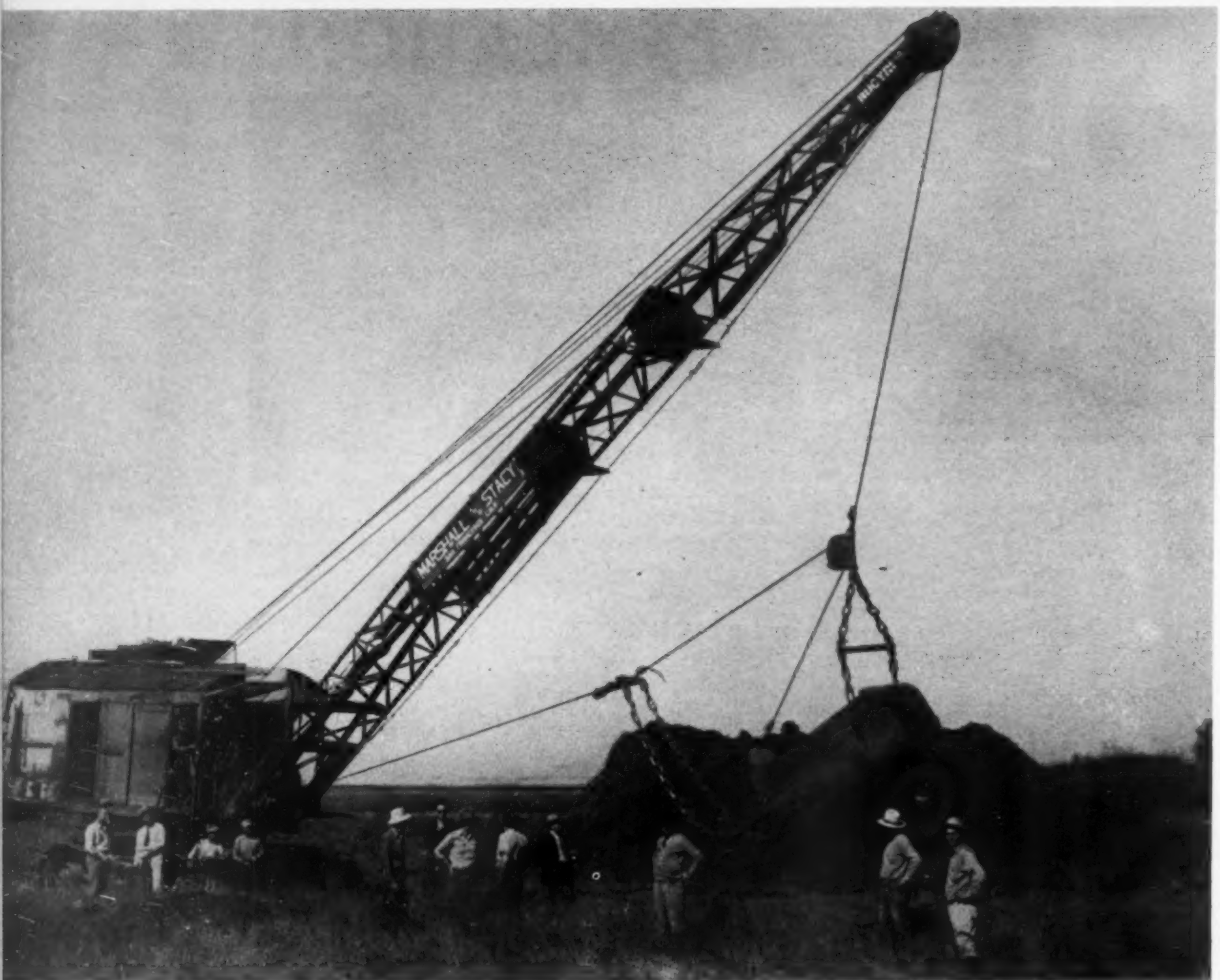
DEB-2

Atlas Diesel Powered Dragline Starts huge Central Valley Project



At the left the Atlas Diesel powered Model 50-B Bucyrus-Erie dragline, owned by Marshall & Stacy, which moved the first dirt of a project of first importance.

THE HUGE Central Valley Project, encompassing flood control, irrigation and power development in the Sacramento and San Joaquin Valleys in California, is off to a flying start, and it is significant that the first dirt to be moved was handled by an Atlas Diesel powered Bucyrus-Erie dragline.

Work has started on the four-mile Contra Costa Conduit, a $100,000.00 canal construction job awarded to Haas, Daughty & Jones, and Marshall & Stacy. The job consists of excavating 600,000 yards of dirt with a time limit of 330 days. This canal is, of course, the initial step in the $170,000,000.00 project, said to be the largest ever undertaken by the Federal Reclamation Bureau.

Atlas Diesels have always been very much in evidence in the construction of great projects. Two Atlas Diesel power units were the first equipment purchased by the Six Companies when they began construction of Boulder Dam. At Bonneville Dam, Atlas Diesels furnished the compressed air and electrical current for the project as well as powering many of the excavators.

Substantial contractors who handle the big jobs the world over have learned through years of experience that Atlas Diesels have the stamina to "take it" on tough jobs, they are economical to operate and their maintenance expense is negligible. No matter what the size of a construction job, whether it's a mile of highway or a project of national importance, you can bank on the choice of the big fellows — Atlas Diesels.

ATLAS IMPERIAL DIESEL ENGINE CO.

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DIESEL PROGRESS

REX W. WADMAN, Editor and Publisher

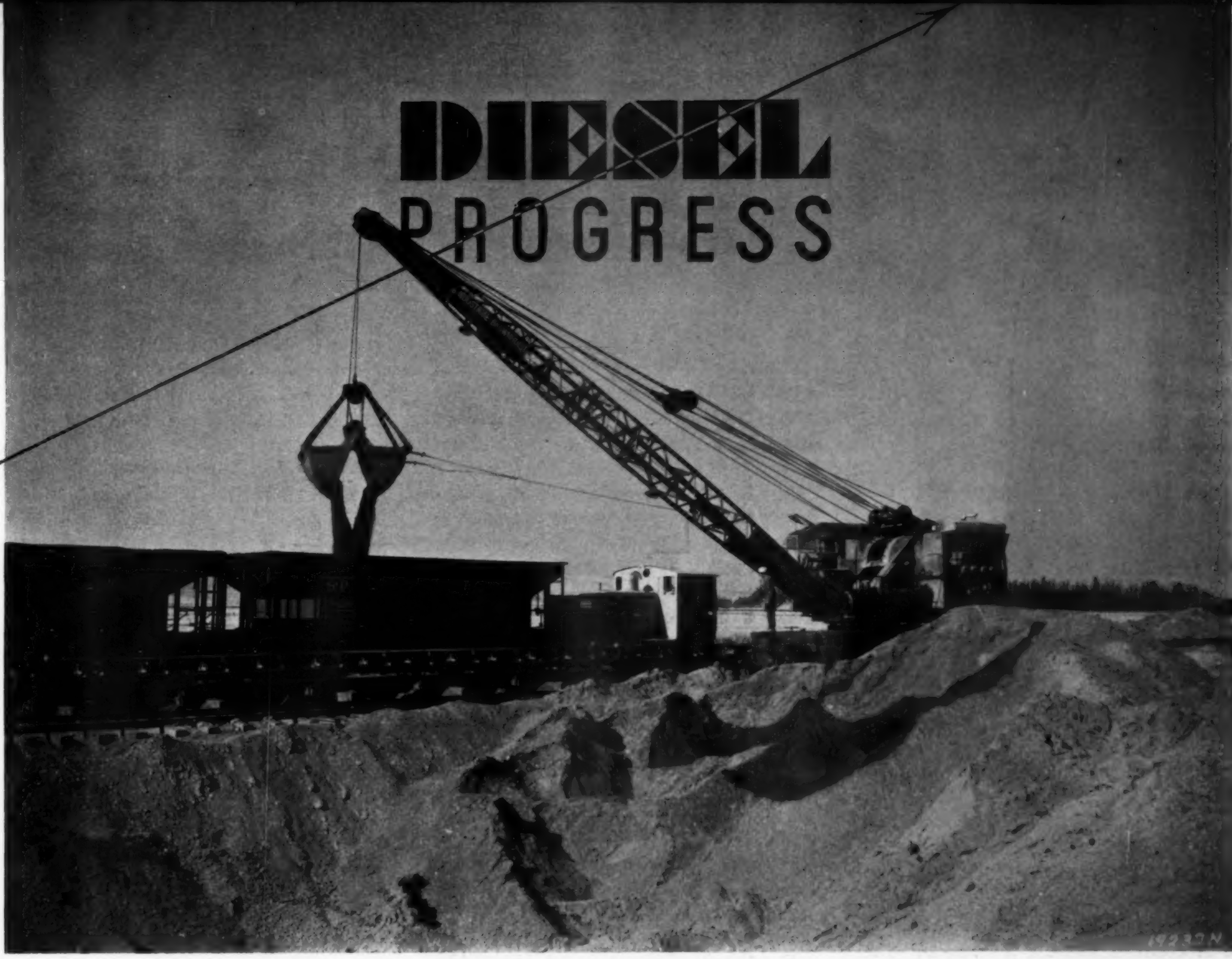
DETROIT, JANUARY 19TH, 1938. History is in the making here today. From coast to coast, in tomorrow morning's newspapers, will appear the news of what General Motors Corporation plans to do in the Diesel field. Details of these plans appear on the first five editorial pages.

With this announcement the whole base of the Diesel industry widens immeasurably. With this announcement the Diesel industry takes on a new stature. It is the greatest single boost the industry has ever received. The magic of the word Diesel tied to the magic of the initials G-M makes a combination which will carry the Diesel industry to heights even I, in my enthusiasm, have never visioned.

What of competition? What does this announcement mean to competition? It means more business, more possibilities, more customers for every engine builder in the business today. The tremendous driving power of General Motors publicity and sales activity will inevitably create a substantial increase in total volume of sales. It will be up to the competition to fight for and get their share of this new business created for them by their new competitor.

No one company can do all of the business. We will all gain by the expansion of the whole market which will inevitably follow this General Motors announcement. It is my firm belief that G-M will create their own customers, that they will take little business away from other engine companies, that they will automatically create a lot of new Diesel customers who won't like their particular type of engine, but will like your type, thus directly and definitely widening each engine builder's market. The whole tempo of our industry started going places today — watch it continue going up all through 1938.

Rex W. Wadman



REX W. WADMAN
Editor and Publisher

FRONTCOVER ILLUSTRATION—A two-yard Osgood "Chief" shovel powered by a Buda Diesel operating in the Santa Ynez Quarry of the U. S. Army Engineers near Santa Monica, California.

TABLE OF CONTENTS ILLUSTRATION—Two Caterpillar Diesel engines furnish the power for all the equipment illustrated in this picture. One drives the Brownhoist and the other is installed in the transfer locomotive. The gravelpit is near Pleasanton, California.

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FEBRUARY CONTENTS

GENERAL MOTORS DIESELS

By REX W. WADMAN

DETROIT, January 19th, 1938. General Motors today launched a program for the manufacture of a complete line of new lightweight, two-cycle Diesel engines.

General Motors has been making large size two-cycle Diesels which have become famous as the engines that made streamline trains possible and have distinguished themselves in marine service during the past four years. These engines have ranged from 600 to 1,200 hp. New products now extend this line in varying sizes down to a one-cylinder 22 hp. model. We might call these new engines the "little brothers" of the engines that power the streamline trains.

The complete line of engines will be built in one existing factory and two new factories, one of which, the Detroit Diesel Engine Division of General Motors Corporation, at Detroit, is in operation, and the other of which, the new engine factory of the Electro-Motive Corporation's Diesel locomotive plant at LaGrange, Ill., will be in operation within a few months. The existing factory is that of the Cleveland Diesel Engine Division of General Motors Corporation, (formerly the Winton Engine Manufacturing Corporation) at Cleveland, Ohio.

The new Detroit plant is located on a 75 acre tract at the Pere Marquette Railroad and Outer Drive. The first unit is laid out for production of fifty engines per 8 hour day.

The development also includes the completion and opening of the new General Motors Diesel Laboratory in a distinctively modern building adjacent to the Detroit manufacturing plant. This is one of the largest and most completely equipped laboratories for exclusive Diesel study in the world.

The product program includes three series of models, based on three different cylinder sizes. The smaller engines have 71 cubic inches per cylinder and the intermediate sizes have 223 cubic inches per cylinder. The larger sizes have 503 cubic inches per cylinder.

The model 71 series will include one, three, four and six cylinder models rated from 22 to 160 hp. maximum at 1,800 rpm.

The Model 223 series will include four, six and eight cylinder models rated for industrial and marine purposes at from 200 to 400 hp.

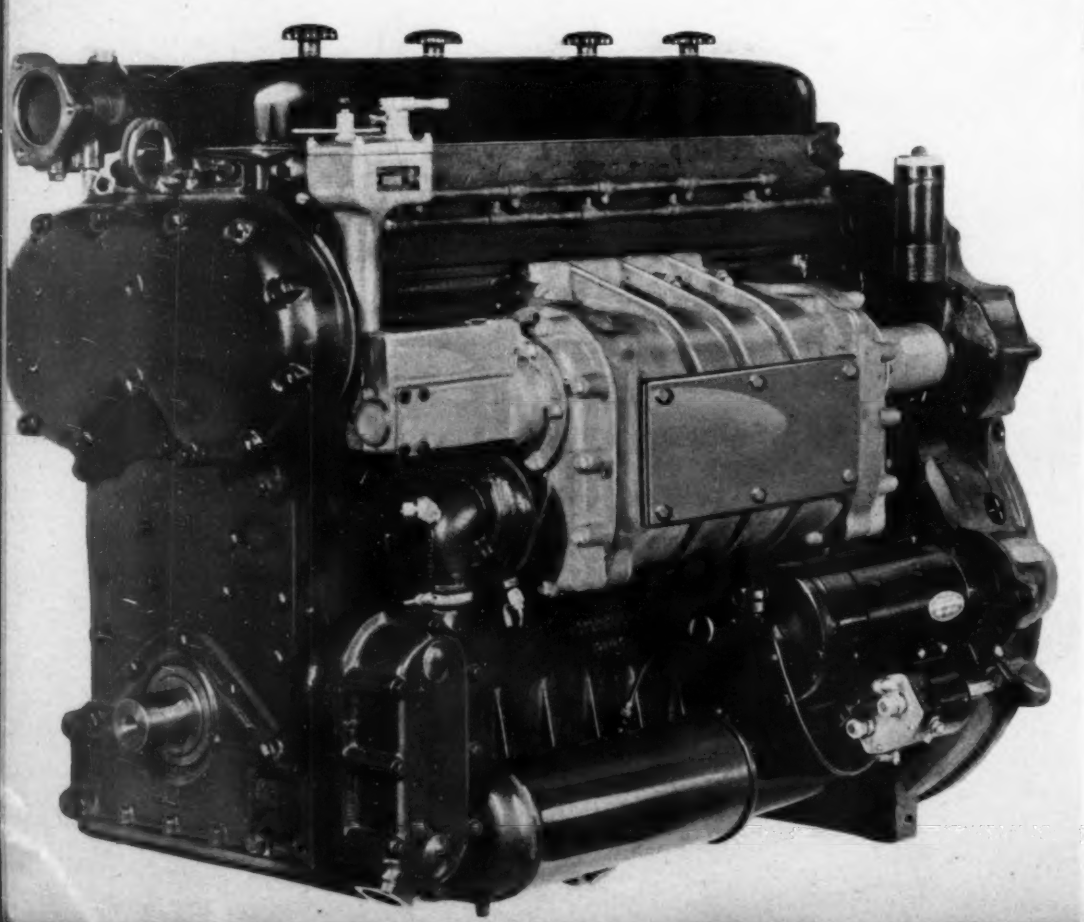
The larger series is the present line of engines now in railroad, marine and stationary power service including eight, twelve and sixteen cylinder engines ranging from 600 to 1,200 hp.

The Model 71 series will be manufactured at the Detroit plant; the 223 series at the Cleveland plant and the larger series at the LaGrange plant.

Heretofore the large engines have been built at the Cleveland plant. Their manufacture will be shifted to the LaGrange plant and the intermediate series assigned to the Cleveland plant because the principal application of the large engines has been in the locomotives built at the LaGrange plant. The Cleveland plant also will continue to custom build engines for the marine field.

An additional operation has been assigned to the Cleveland plant. It is the intention to sell complete "power packages" for industrial and agricultural applications. By this we mean an engine equipped with all accessories necessary to start the job for which the customer intends to use it. Heretofore it generally has been necessary for the customer to do considerable of the assembling of necessary appurtenances to complete an installation, such as special foundations isolated for vibration and noise, fuel supply systems, special water cooling systems and muffling equipment. Complete units have been designed that will be delivered with all of the necessary equipment to start working as soon as it is set in the place desired by the customer. For instance, in the case of a stationary electric power plant, the "package" will include the engine, the generator, fuel supply equipment, switch board, radiator or heat exchanger, base and any other necessary equipment. The assembling of this equipment into the complete "package" will be done, on engines of all sizes, at the Cleveland plant.

Engines in the 71 series are now in production at the Detroit plant. Dates for the inauguration of the new production programs at Cleveland and LaGrange plants will be announced later. Meanwhile, the present production program at the Cleveland plant which is working on railroad and marine orders is not affected.



General Motors Model 6-71, 2-cycle Diesel engine.

Sales of the engines for railroad motive power will continue through the Electro-Motive Corporation at LaGrange. Sales in other fields will be through the Diesel Engine Division of General Motors Sales Corporation, with headquarters at Cleveland. A complete national distribution system with dealers in principal cities is being built. A national service and parts organization centers around the widespread warehousing facilities of General Motors Parts Corporation. General Motors Acceptance Corporation will participate in wholesale and retail financing.

The Gray Marine Motor Company of Detroit has been given a franchise for the adaptation and sale of the 71 Series engines for marine purposes.

Another important outlet will be to manufacturers for powering such products as tractors. road building machinery, mining machinery and the like.

THE NEW LINE OF ENGINES

The two-cycle Diesel engines as developed by General Motors have much the same construction and appearance as conventional four-cycle gasoline and Diesel engines. The cylinders are cast en bloc with removable dry liners. The cylinder head is a one-piece removable unit with overhead valves. The valves are operated through rocker arms and push rods from a camshaft located in the upper part of the cylinder block. The camshaft is driven by a train of gears which also drives the blower. The water pump, fuel transfer pump and Handy governor are mounted on the blower and driven by it. The oil pan and valve covers are one piece pressed steel units.

In order to function as a two-cycle uniflow engine the cylinders are made with inlet ports, through the liner and water jackets at the bottom stroke position, which connect the cylinder to the air box surrounding the cylinder proper when the ports are uncovered by the piston. The blower is flange mounted on the side of the cylinder block and discharges directly into the air box.

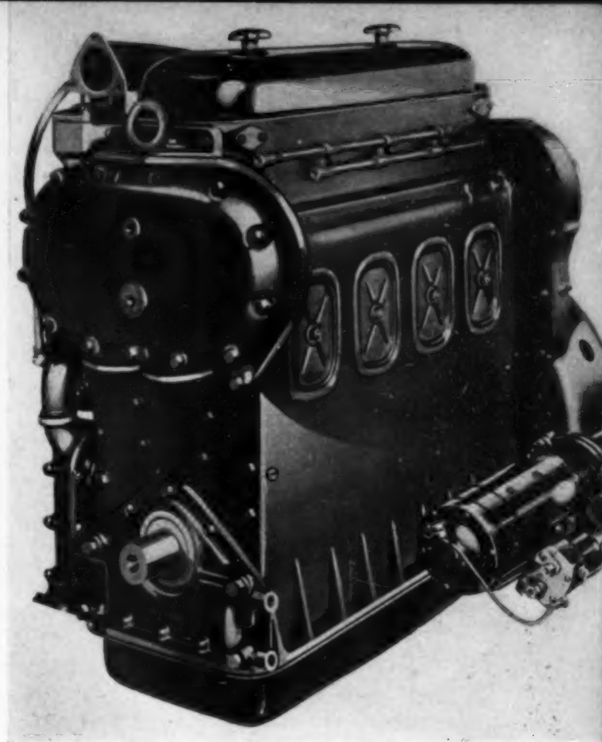
The fuel is sprayed into the cylinder by a combined pump and spray nozzle or unit injector located between the valves in the cylinder head and operated from the camshaft by a rocker arm, like the exhaust valves.

The only really new design feature of the engine is the provision for completely balancing the engine. With the camshaft arranged to give uniform firing of all the cylinders each revolution and thus obtain the smoothness equal to four-cycle engines of double the number of cylinders, there results a small fore and aft rocking couple. This has been completely balanced out by small counter-weights at each end of the camshaft, and a second similar shaft on the other side of the cylinder block. This device makes it possible to produce engines of 1, 2, 3, 4, 5, 6 or more cylinders that are free from unbalanced forces or couples. This balancing system and the inherent symmetry of the two cycle uniflow type of cylinder offers an entirely new approach to the problem of engine models covering a range of power requirements with various accessory arrangements and different direction of rotation.

The cylinders are the same size for all models in the 71 series, one, three, four and six. The front end of the cylinder block of all models is exactly like the rear end, and in a like manner the cylinder head, blower, bearings, etc., are all alike on each end. The only difference between the three and the six is that three more cylinders have been added in the middle of the engine, and the crankshaft, camshaft, blower, etc., lengthened accordingly. The pistons, valve gear, connecting rods, bearings, pumps, timing gears, flywheel housings and like parts are all identical for all models and completely interchangeable. The machining dimensions of all cylinder blocks and heads are identical except for length.

But perhaps the most interesting feature is that the entire cylinder block and blower assembly can be turned end for end without disturbing the flywheel or gear train, and thus place all the accessories on the opposite side. In a similar manner the cylinder head can be reversed regardless of the position of the blower, and place the exhaust and water manifolds on either the opposite side or the same side as the blower. By shifting one gear in the gear train, and changing the camshaft and oil pump cover, the rotation of the crankshaft can be made either clockwise or anti-clockwise with any of the above accessory arrangements. The generator and air compressor, or vacuum pump, can be mounted over the gear housing and driven direct from the cam and balance shafts, or attached to the side of the crankcase and belt driven. The fuel injectors are identical for all models. All these assemblies can be made with but a few right and left hand parts, the result being eight distinct models of each engine size.

It is obvious that this similarity of parts and the reduction in the number of different kinds of parts has had a marked effect on the production machine and tool set up. Many of the machines and fixtures take the parts for all models. This permits volume production methods to be applied where the number of models would otherwise make the tooling cost prohibitive.



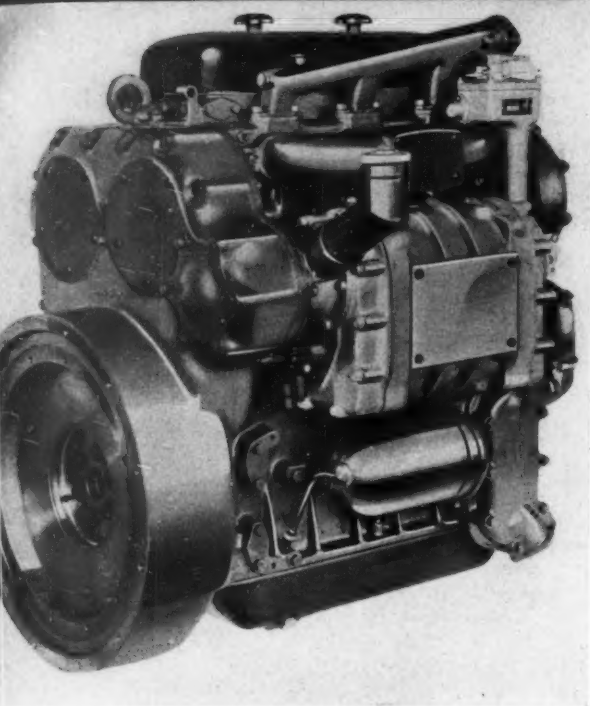
General Motors Model 4-71, 2 cycle Diesel.

The adaptability of these power plants to a great variety of uses is also an outstanding feature; such as right and left hand twin screw marine installations, left hand engines for rear engined coaches with the accessories all on the open side, right or left hand drive trucks, marine engines with the gear box on the front end of the engine, Diesel electric generator sets, etc. But it is believed that the greatest benefit will be derived by the engine user on account of the simplified service problem regardless of whether he has a truck, a boat, a stationary electric plant, an irrigation pump, a cotton gin, a crane, an air compressor or a tractor.

These engines are primarily internal combustion power plants, compact in form, light in weight, made of ordinary materials, having parts that are familiar to everyone, and require no special training to operate or service. The fact that they are called Diesel engines is of little consequence—the important thing is that they use less fuel and fuel that costs less. It is on this fact alone that the Diesel engine business must be built.

THE NEW PLANT

A compact, highly efficient plant designed exclusively for the production of high-speed Diesel engines on a mass production basis became the focal point of engineering attention when General Motors Corporation today threw open to the inspection of technicians the new plant of its Detroit Diesel Engine Division.



General Motors Model 3-71, 2 cycle Diesel.

A new standard of well-planned layout and operating efficiency may well be set up by the new plant, for it was conceived simultaneously with the development of the product itself. As a result, the factory has been built and equipped to meet the requirements of product design in every particular.

Even a cursory inspection of the factory indicates that questions long debated in Diesel circles have been answered — that small, high-speed Diesel engines are practical, that they can be built economically by mass production methods, and that they can be built by that method according to standards even more exacting than the high requirements of the mass-production automobile industry.

Perhaps the most important fact about the new plant is that its manufacturing facilities are to be devoted exclusively to the building of an integrated line of industrial Diesel high-speed engines readily adaptable for all manner of applications of Diesel power — for stationary power plants, for industrial and road building machinery, for tractors, trucks and buses. The plant will produce four engines built around one basic cylinder size and design — a one cylinder engine — a three-cylinder engine, a four, and a six. All are designed on the two-cycle principle.

Culminating many years of development and experimental production, the keynote of this operation is PRECISION. As the details of the manufacturing procedures are unfolded, one will appreciate how the most modern production machinery, some of which had to be specially designed and built for the specific purpose, has placed the most exacting machining operations on a basis that is exact and reproducible and subject to conventional production controls. In effect, the individual skills of the finest instrument makers have been mechanized so as to produce interchangeable parts on a mass-production basis within tolerances to which no hand-skill can ever aspire.

It was mentioned earlier that the entire line of engines is designed about the principle of a single basic cylinder size. Thus it is possible to produce in quantity, on the same machines, all of the parts of a cylinder such as the dry liner, piston, connecting rod, bearings, etc., and then assemble these standard interchangeable elements into engines of one, three, four, or six cylinders with all the economy of a single size of engine.

The factory proper consists of a monitor-type structure, 240 feet in width and 480 feet in length. It is of the latest factory building construction with the maximum of window glass area so as to provide the workers with the best possible conditions for seeing. Worker comfort is further enhanced by the use of high ceilings, spacious work places and aisles, and excellent paint treatment that serves to reflect and make the most of the daylight.

Within the structure of the various Diesel engine units of General Motors Corporation, announced recently, it is of interest to note that the Detroit plant is the focal point for coordinated engineering and test facilities for all plants in the new set-up. The engineering department designs all Diesel engines developed for the Corporation while the testing laboratory contains personnel and equipment for carrying on this work for the entire group.

A brief excursion through the plant reveals the fact that it is divided into various functional activities. Traversing the plant in its length, one will find that its largest area is devoted to the machine lines for producing the major parts of the engine. Next is the experimental machine shop in which are built experimental engines for future development. Finally at the far end of the building will be found the injector department which manufactures and tests all fuel injectors used on all G. M. Diesel engines wherever they are produced.

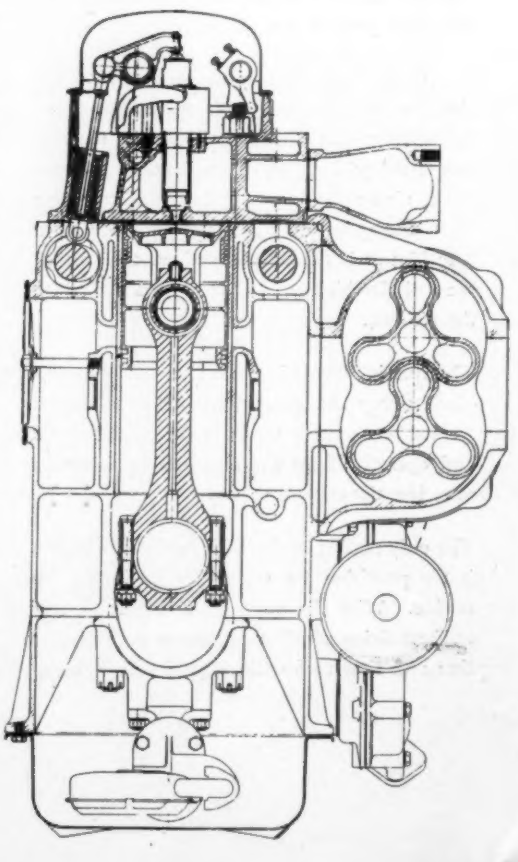
The main power plant comprises a boiler room and a power department. The boiler room contains a modern oil-fired boiler as well as an electrically heated boiler. The power department contains three main Diesel-electric stationary generating units powered by an eight-cylinder, a twelve-cylinder, and a sixteen-cylinder General Motors Diesel engine, respectively. The eight and twelve cylinder units produce 550-volt DC current, while the big engine produces 4,600-volt AC current.

The power section also contains a three-unit motor generator set, power distribution switchboard, and power transformers. The AC power line is stepped down by transformers in the laboratory building and in the main plant to 440-volt and 110-volt current depending upon its usage.

Overall efficiency of the whole operation is raised to an unusually high level by utilizing the electric energy generated at the ten production test stands in the factory as well as from the endurance test stands in the laboratory. Thus, even the energy that is ordinarily wasted through resistance grids is available, when required, as a source of productive power.

The feature of the laboratory is its group of eight test rooms, each one fitted with the most modern dynamometer equipment and complete instrumentation for precise recording of scientific measurements of engine characteristics. As noted earlier, this laboratory coordinates the fundamental test work for all GM Diesel activities. For this reason, the rating and size of dynamometers in each department differs according to its function. The large engines are tested against generators.

Adjacent to the machine shop is the engine assembly line, running at right angles to machine lines. And adjoining this is the final



test department where all engines are subjected to hours of dynamometer testing before they are released for shipment. The electrical equipment is so arranged as to absorb the power of the engines on test, and to transmit it in the form of electrical energy to the main power plant, thus converting waste power into useful and usable energy.

Precision operations are keynoted in the machine shop. Here will be found the most modern of the precision boring machines, diamond-boring machines, centerless grinders, honing machines, and similar equipment associated with precision manufacture.

One of the most important of the precision operations is that of producing piston and connecting rod assemblies. In most cases of automotive engine production, these assemblies are permitted to vary between fixed limits and then are assembled into balanced sets by selective matching of pistons and rods. At the Detroit Diesel plant this procedure is not tolerated. Each of the parts is interchangeable as to size and weight with its fellows and each assembly conforms to the same weight specification. This is achieved by the use of ingenius machines which automatically weigh the piston or the rod and machine it precisely to the weight required.

Outer diameters of pistons and cylinder liners are finished to close limits both as to size and surface quality by operations on centerless grinders – huge machines of the very latest type.

Connecting rods not only are precision-bored to achieve the desired control of size and roundness but are subsequently honed to produce the desired surface finish.

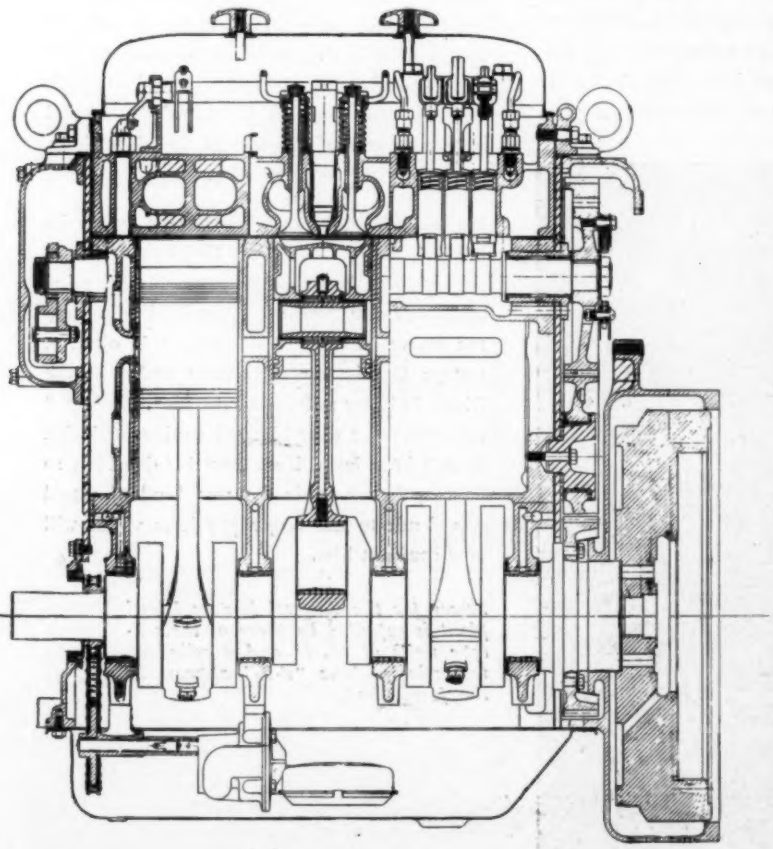
The interchangeability mentioned earlier finds its best expression in the machine lines for the large units such as cylinder blocks and heads. Consider that such equipment is most expensive as to first cost and requires, in addition, expensive jigs and fixtures for the character of precision demanded here. Here is one of the best examples of the coordination of engineering design and production planning to be found anywhere. Cylinder blocks and cylinder heads are so designed as to be geometrically similar for all sizes and end-for-end. What this means is that no matter how you turn the casting, both ends have the same shape and take the same number and spacing of holes. Moreover, the ends of all blocks, whether they have one, three, four, or six cylinder barrels, are precisely alike, and the drilling of the top and bottom is the same save for the fact that a larger block will have more holes.

This basic conception of design makes it possible to use but one line of special machines for the entire range of engines no matter what number of cylinders. Yes, it even goes further since the similarity of the blocks makes it possible to use many fixtures interchangeably and utilize multiple-spindle drilling and tapping heads without change.

How completely this philosophy has penetrated production planning may be gauged by the set-up for boring the dry cylinder liners which are assembled into the engine barrels. For boring, the liners are assembled, three at a time, into a huge fixture which has the same form and size as a three-cylinder cylinder block. Then the fixture with its charge of liners goes into the same machine and same fixtures are used for boring the cylinder barrels. The only change required is to replace the boring cutters with cutters of smaller diameter, a matter of only minutes for the changeover.

The blower department is a gem of perfection and mechanical ingenuity, and probably the first of its kind in this country. Its chief attribute is the simplicity of equipment and process for an operation so intricate and precise. Several examples will suffice to give the picture. For example, the blower housing has two bores that must be finished to accurate limits. This is done by boring the housing on a single-end precision boring machine with its massive boring spindle. As one bore is finished, the table indexes the work forward, hydraulically, to complete its mate. However, this is but a roughing operation. Subsequently, each housing is processed in the same machine for a second and final boring operation.

Machining of the blower rotor is a very unique operation. The rotor is a three-lobed affair, each lobe having a spiral form along its axis. There is one specially designed machine set-up to handle this operation automatically. It takes three separate settings of the rotor to complete the job, using a special formed cutter that encompasses a third of the profile each time.



GENERAL MOTORS DIESEL ENGINES
Model 71 Series
GENERAL SPECIFICATIONS

	Model 3-71	*Model 4-71*	*Model 6-71*
Number of Cylinders	3	4	6
Bore and Stroke, inches	4¼ x 5	4¼ x 5	4¼ x 5
Total Displacement, cubic inches	212.69	283.58	425.37
Maximum Hp. Output @ 1800 rpm.	80	107	160
Continuous Hp. Rating @ 1200 rpm.	45	60	90
Continuous Hp. Rating B.M.E.P.-lbs./sq. in.	70	70	70
Maximum Torque, lbs. ft	283	375	562
at rpm.	800-1000	800-1000	800-1000
Compression Ratio	16:1	16:1	16:1
Piston Speed – ft./min. @ 1200 rpm.	1000	1000	1000
Number of Exhaust Valves per Cylinder	2	2	2
Exhaust Valve Diameter	1 11/16″	1 11/16″	
Exhaust Valve Seat Angle	45°	45°	
Exhaust Valve Lift	.375″	.375″	
Firing Order: Clockwise (cranking) Rotation	1-3-2	1-3-4-2	1-5-3-6-2-4
Firing Order: Counter Clockwise Rotation	1-2-3	1-2-4-3	1-4-2-6-3-5
Number of Main Bearings	4	5	7
Main Bearing Diameter	3½″	3½″	3½″
Main Bearing Length	1⅛″	1⅛″	1⅛″
Main Bearing Projected Area, sq in.	15.76	19.7	27.58
Crankpin Diameter	2¾″	2¾″	2¾″
Crankpin Bearing Length	1 25/32″	1 25/32″	1 25/32″
Crankpin Bearing Projected Area, sq. in.	14.7	19.6	29.4
Clutch Size	14″	15½″	17″
Weight of Basic Engine (dry)*	1160 lbs.	1330 lbs.	1635 lbs.
Fuel Consumption, lb./bhp. hr.	.45	.45	.45
CAPACITIES			
Lubricating Oil System, qts.	8½	10½	15½
Fuel Oil Tank, gallons	30	40	55
Cooling Water, gallons	11	12½	15½

*Engine weight includes: Starting Motor, Governor, Oil Cooler, Oil Filter and Fuel Filter. Generator, Cooling Fan, Oil Bath Air Cleaner, Air Intake Elbow and Engine Mountings are not included in the above weights.

As the cutter traverses the face of the rotor, the rotor casting is automatically turned by an indexing mechanism so as to produce the spiral form.

After machining, each rotor goes to a balancing machine, where it is checked and drilled if necessary to produce the described limits of balance.

Crankshafts, which are all Tocco hardened under the Ohio Crankshaft Company's system of Tocco hardening (all camshafts are also Tocco hardened) are checked 100 per cent for static and dynamic balance, using the standard GMR balancing machine. However, a distinctive feature of this machine quite in keeping with the production thinking in this plant is the fact that it also is used for balancing flywheels.

With these high-spots of the machine shop, we turn naturally to the Precision Manufacturing Department — in a niche all its own — which produces the fuel injectors for all Diesel engines built by General Motors. In its present form it represents the hitherto unattainable objective of translating the skill of the instrument maker into mechanized operation that achieves unbelievably precise manufacturing limits in interchangeable and reproducible parts — something that transcends human skill.

One may gain a good picture of what has been accomplished by considering a few of the measurements that are made mechanically.

Consider that the maximum clearance between the barrel or bore of the injector and the plunger which moves it must not exceed 50 millionths of an inch!

Consider further that at the tip end of the injector, the maximum clearance between the needle valve and the bore within which it seats must be less than one ten-thousandth of an inch.

What better impression can we give of the precision in this department than to say that the general run of the limits on all parts of the injector, apart from those mentioned above, is of the order of one ten-thousandth of an inch?

When such amazing figures are quoted publicly, it is only logical for our readers to question whether such limits of precision actually can be measured and proved. The answer is emphatically yes! Every one of these parts is measured by a remarkable instrument called the Electrolimit gauge which is accurate to the millionth part of an inch and gives an exact reading on a large calibrated scale. When you examine this scale you will find that the measurement of one ten-thousandth of an inch — too small to comprehend — is shown on a scale some five inches in length, larger than the scale of one of the dash instruments on your automobile.

Another big problem was the matter of drilling the spray nozzle holes. They are tiny, as holes go, but in addition to accurate sizing the holes must be drilled at correct angles with precise spacing.

These holes are of various diameters, depending upon the size of the engine. The general range lies between six-thousandths and fourteen-thousandths of an inch in diameter. Drilling is done by means of tiny drilling machines designed here, in which the drill is rotated at extremely high speeds by means of a tiny air-operated turbine — small in size but similar in principle to the huge turbines used for generating power. The tiny jeweler's drills are so sensitive to pressure that they cannot be fed into the work by mechanical means. So the drill spindle floats and is pressed into the work by the operator's finger as the drill rotates.

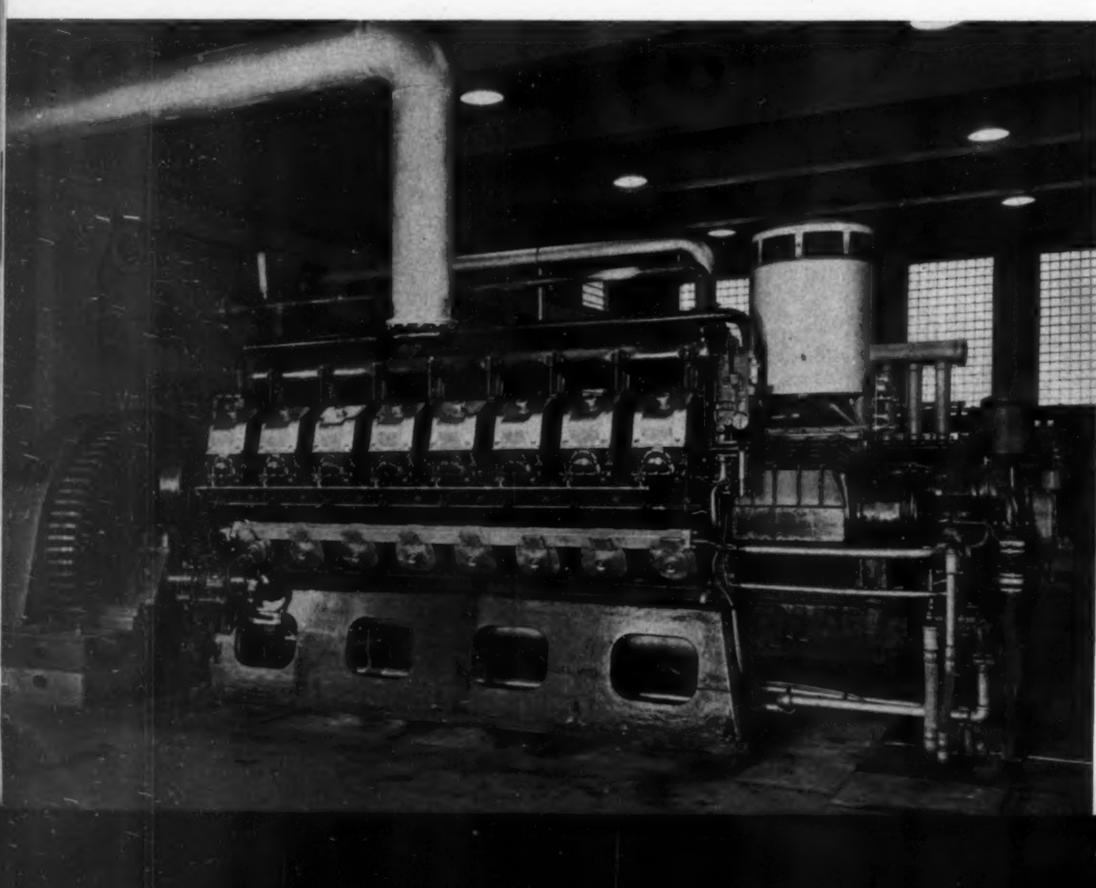
Finally, it is well worth noting that all precision grinding operations on injector elements are performed in a centralized grinding department, located in the precision machining department, but completely isolated from it. This is done for two reasons. First, it keeps the precision grinding department clean and free of any dust or dirt; second, it protects the precise drilling and lapping operations in the other department from the fine dust and grit that may originate from the grinding wheels.

CODRINGTON KEEPS PRESIDENCY

WITH the passing of the Winton name, the Winton plant becomes the Cleveland Diesel Engine Division of General Motors Corporation. George W. Codrington will remain as president of the Cleveland Division and also as president of the new Diesel Engine Division of the General Motors Sales Corporation, which will market the output of all three General Motors' Diesel plants.

Establishment of the entire Diesel sales division in Cleveland brings several General Motors executives to that city. Among them are: William J. Davidson, general sales manager of the Diesel sales division; Max H. Schachner, assistant general sales manager, and R. J. Walker, a former lieutenant commander in the U. S. Navy, who will be in charge of heavy engine sales in the marine field. All formerly were located in the Detroit office. J. B. Jackson, who has been in Cleveland for several months as general manager of the plant there, remains in the same capacity.

We publish the above information to clarify the position of George W. Codrington and to answer the thousands of questions clearing across our desk recently "what is Mr. Codrington going to do?" The answer is obvious, George Codrington will be as active in the Diesel Industry as he has ever been. Enlarged responsibilities offer him enlarged possibilities. Details have been lifted from his shoulders so he may better apply the vast fund of actual experience to the larger problems which will now confront him.



Power for the General Motors Diesel plant is supplied by three of their V-type units of 16, 12 and 8 cylinders, respectively. The "V-16" appears in the foreground.

The Diesel fire truck ready for service presents a very efficient, business-like appearance.

AMERICA'S FIRST DIESEL FIRE-TRUCK

THE old custom of taking to a fire a highly explosive load of gasoline with each fire truck has been challenged with the newest development in fire trucks. Instead of a gasoline engine for power, a modern Diesel engine is under the "bonnet" of this new truck, and both shop and service tests show many advantages in favor of it.

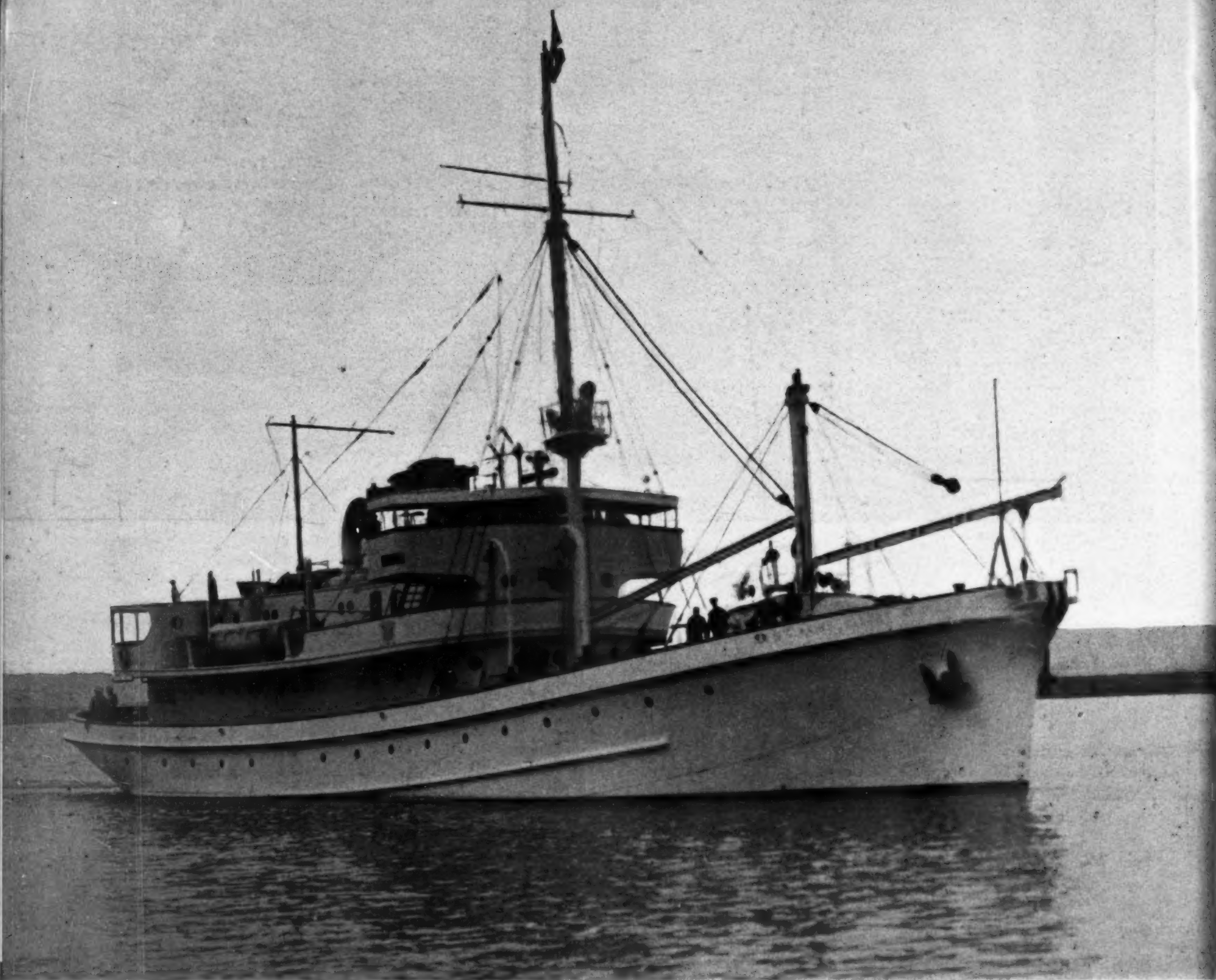
The fire-fighter is a Stutz model F-D unit with a wheelbase of 173 inches. Capable of pumping 1,000 gpm., it represents the latest engineering practices throughout. A six-cylinder Cummins Diesel rated at 155 hp. at 1,800 rpm., drives the truck through a Fuller five-speed transmission and a Timken worm differential. When at the fire the Cummins drives the geared Stutz positive displacement rotary fire-pump. At 120 pounds pressure its capacity is 1,000 gpm., and at 200 pounds pressure, 500 gallons is discharged. Hydraulic brakes are provided on both the front and rear wheels. Two large reels and two ladders are standard equipment.

The outstanding feature credited to the Cummins Diesel for use in fire-trucks is its ability to start instantly regardless of weather conditions — ability to take the load immediately without choking or flooding — immunity to being killed from water getting on ignition wires, or in carburetors because the Diesel has neither — and the reduced fuel consumption.

It is not uncommon for fire trucks, at a stubborn fire, to need refueling. Transferring gasoline under such circumstances is always a risk, whereas with the Cummins Diesel powered fighter the interval between refuelings is only about half as often and when necessary it can be done without danger of creating another fire.

The Diesel used in this new Stutz truck is identical to the thousands of Cummins Diesels operating all over the United States by highway truckers. The engines in highway service have saved millions of dollars for their owners in fuel bills alone, in addition to a marked reduction in maintenance costs.

Close-up with hood raised shows the Cummins Diesel to excellent advantage.



U.S. ARMY MINE PLANTER *"Ellery W. Niles"*

THE LATEST DEVELOPMENT IN DIESEL ELECTRIC DRIVE

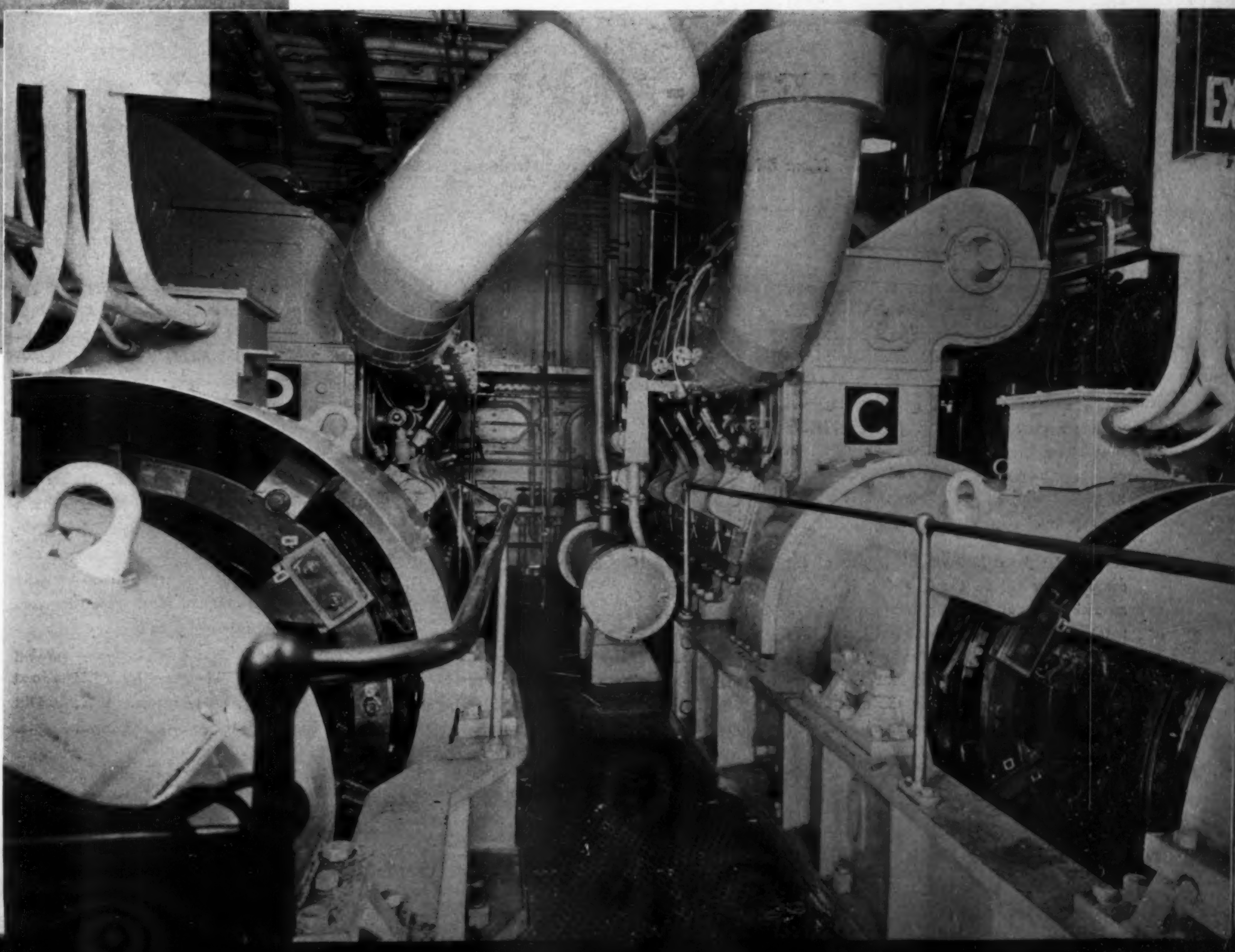
The "Ellery W. Niles" demarks a splendid example of the application of Diesel Electric Drive. The highly specialized service to which this vessel will be put calls for the closest degree of maneuverability, which is only obtainable with electric drive.

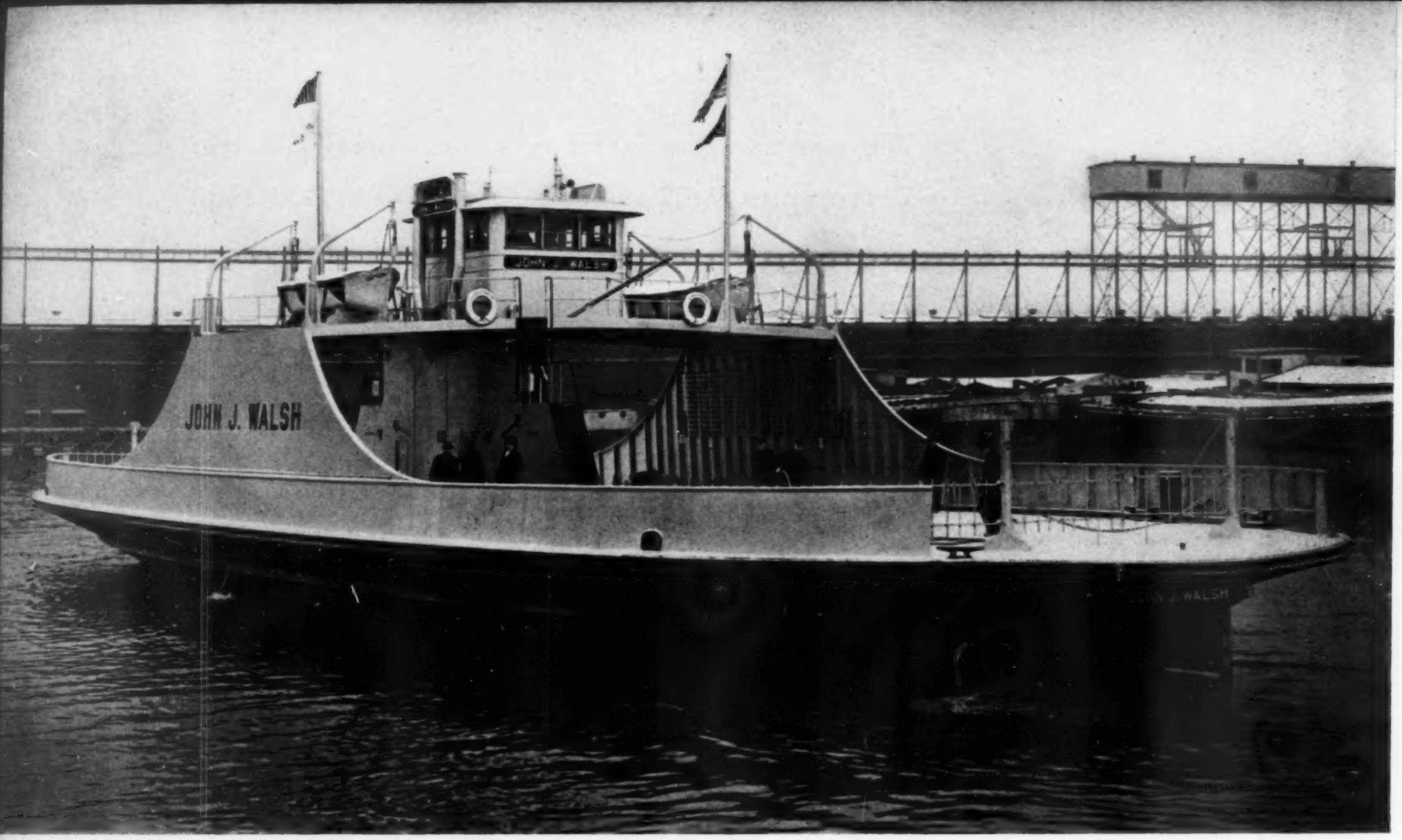
The "Ellery W. Niles," is 185'x35'x17'3", twin screw, Diesel Electric Drive Mine Planter and Cable Layer. Power plant consists of three 600 hp. six-cylinder, Winton Diesel main engines and one 90 hp. 60 kw. Winton Auxiliary Generating Set.

GENERAL MOTORS SALES CORPORATION

DIESEL ENGINE DIVISION • CLEVELAND, OHIO • U. S. A.

- We are now prepared to offer Diesel Electric Drive units for Towboats from 500 to 3000 hp.
- For self-propelled barges and inland waterways tankers up to 5000 hp.
- For main ship propulsion, in multiple units, up to 10,000 hp.
- Stationary Power Plants in units from 200 to 1200 hp.





Another streamlined Diesel ferry starting on what proved to be an entirely satisfactory trial trip. Less than a week later it was in active service.

YONKERS-ALPINE FERRY

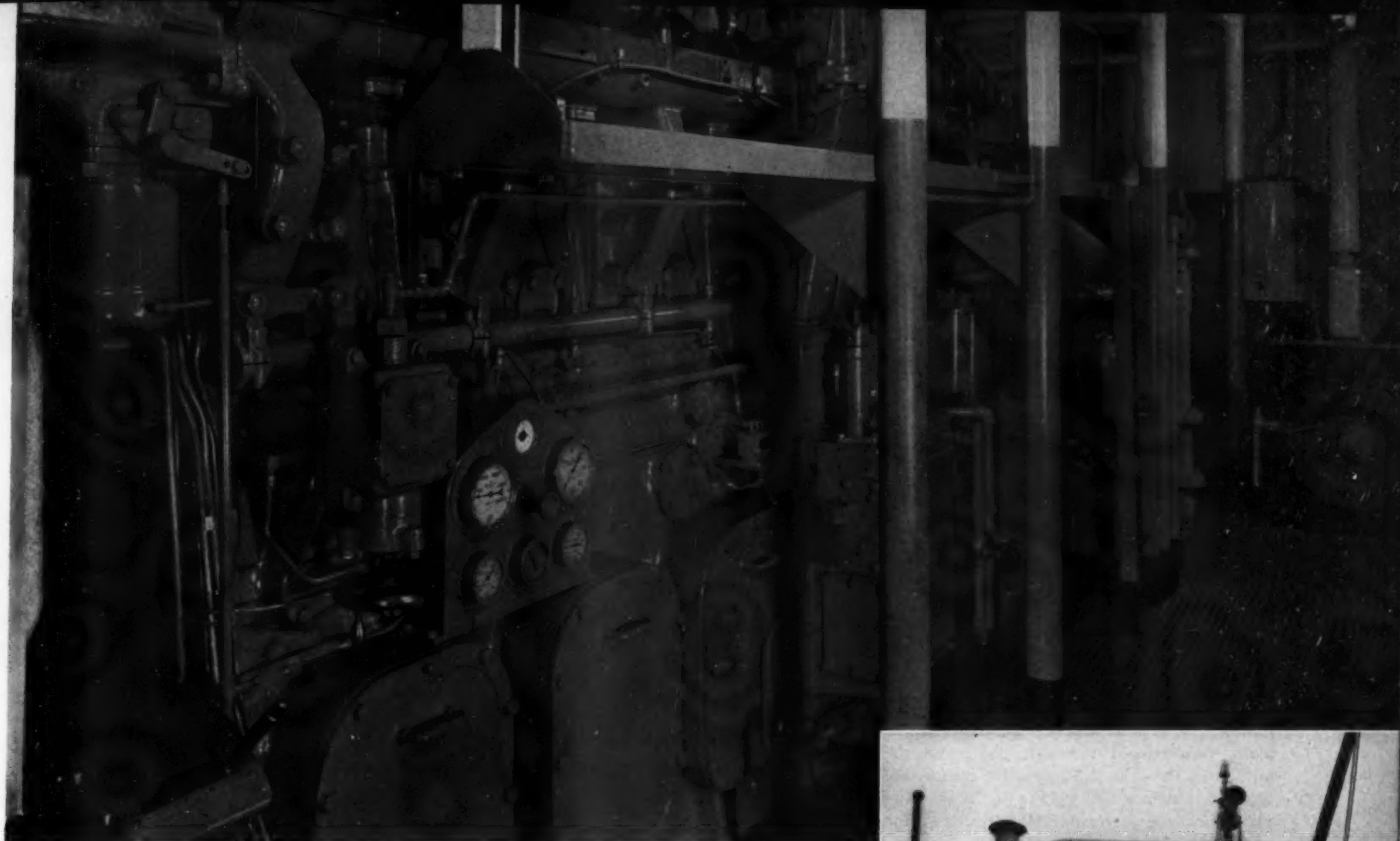
New Diesel Streamliner for Hudson River Service

FOR the past fifteen years the Westchester Ferry Corporation has been operating on the Hudson River between Yonkers, New York, and Alpine, New Jersey. During this period two steam vessels have handled the traffic which consists mainly of motor trucks and passenger cars. On Friday, January 14th, a new, streamlined Diesel ferry was placed in operation to provide better and faster service to the traveling public and to reduce operating expense.

Named the *John J. Walsh,* in honor of the company's president, the new ship is already attracting an unusual amount of favorable attention and comment. Mr. Walsh and Mr. Leo E. Schwarzstein, Vice President and General Manager of the Westchester Ferry Corporation, are responsible for the selection of Diesel propulsion. After a year of exhaustive personal inquiry and investigation they were convinced that this type of power is ideal for their requirements and engaged Eads Johnson of New York as naval architect.

Principal dimensions of the *John J. Walsh* are: length – 153 feet; breadth of hull – 38 feet; overall beam – 48 feet; and draft – 8 feet, 6 inches. The vessel has a capacity of approximately 36 automobiles with sufficient headroom to accommodate any commercial truck which meets legal operating requirements. The hull and superstructure are welded throughout with welded steel tread plates on the main deck. The pilot house, amidships, provides unobstructed visibility in all directions and is equipped with dual engine room telegraphs and helms since the boat is intended to operate in either direction without turning at the end of each run.

For main propulsion, a six cylinder, 650 hp. Cooper-Bessemer Diesel was selected which is directly connected to two Ferguson propellers, one on each end. Double rudders are likewise fitted. The main engine carries a Gardner-Denver compressor, a Weston electrical tachometer and Purolator fuel oil filters. Additional auxiliary equipment includes a six point Brown exhaust temperature pyrometer, Andale lubricating oil strainers and a Maxim exhaust silencer and spark arrester. Belt driven from the main shaft is an Electro-Dynamic generator which floats on the line with Edison batteries of 150 amperes and 110 volts. From the same shaft on the other end a belt drives an Ingersoll-Rand compresser which furnishes starting and steering air. The vessel has a Lidgerwood compressed air steering system. A 12 hp. Hill Diesel and a 5 hp. Atlas Diesel furnish power



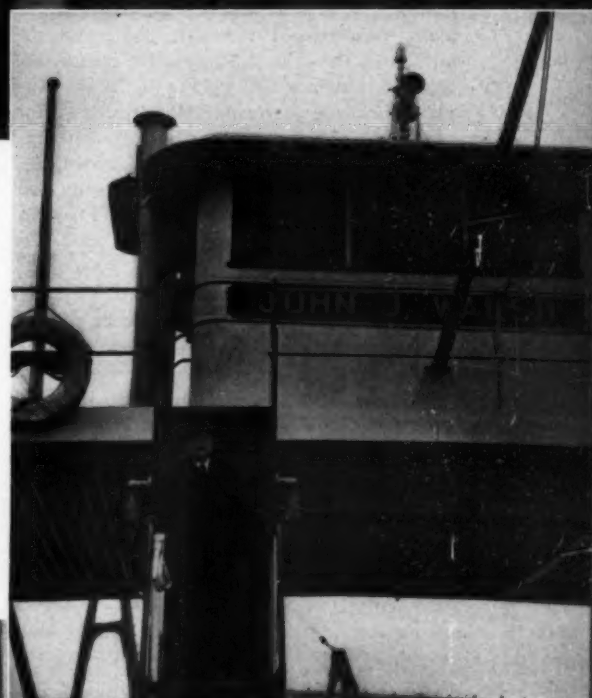
for fire and bilge pumps and an additional air compressor, respectively, the former driving through a Morse chain. Both of these smaller Diesels are also fitted with Maxim silencers on their exhausts. The ship's sanitary pumps are motor driven with both pumps and motors furnished by Fairbanks-Morse & Company. Four tanks of Lux manual controlled carbon dioxide gas provide fire protection for the engineroom.

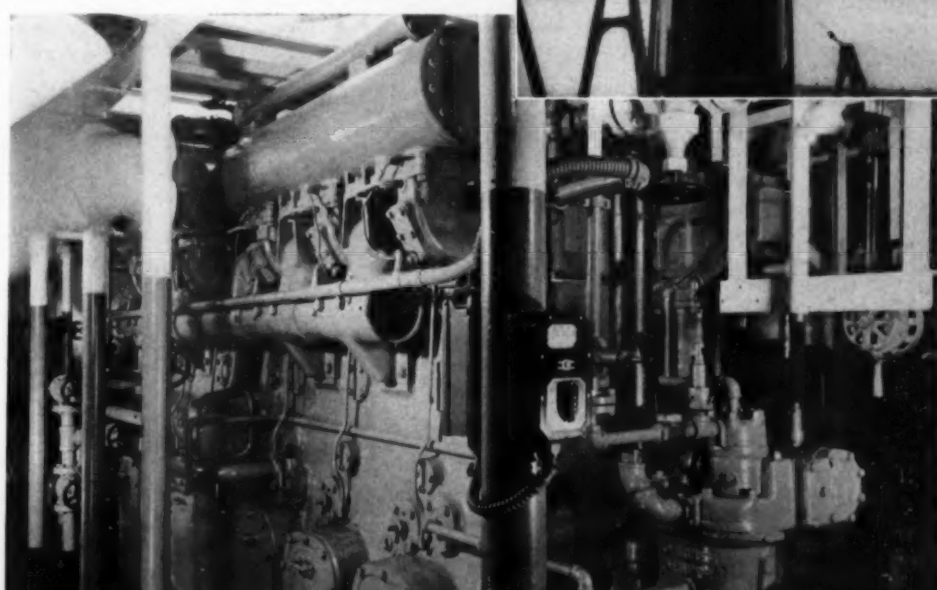
With all the above mentioned auxiliary equipment it is remarkable how neat and shipshape the engineroom appears as can be seen by the accompanying illustrations. Each unit has been placed to the best operating advantage yet the final result has produced an engineroom with plenty of space for personnel to work with maximum efficiency. On the trial trip and in subsequent actual service all bridge signals have been handled with the utmost dispatch and all equipment has functioned perfectly. With an average speed with and against current of 12.5 miles per hour, the *John J. Walsh* has met all operating specifications with plenty of power to spare. The present schedule calls for five minutes per crossing with a ten minute stop-over at the slip or a total of twenty minutes per round trip. On this basis the new Diesel ferry will supersede both of the former steam vessels except during rush periods.

Control side of the Cooper-Bessemer 650 hp. Diesel directly connected to propellers fore and aft. The 12 hp. Hill Diesel appears in the background.

Right — Mr. John J. Walsh, president of the company, inspects the new Diesel vessel bearing his name.

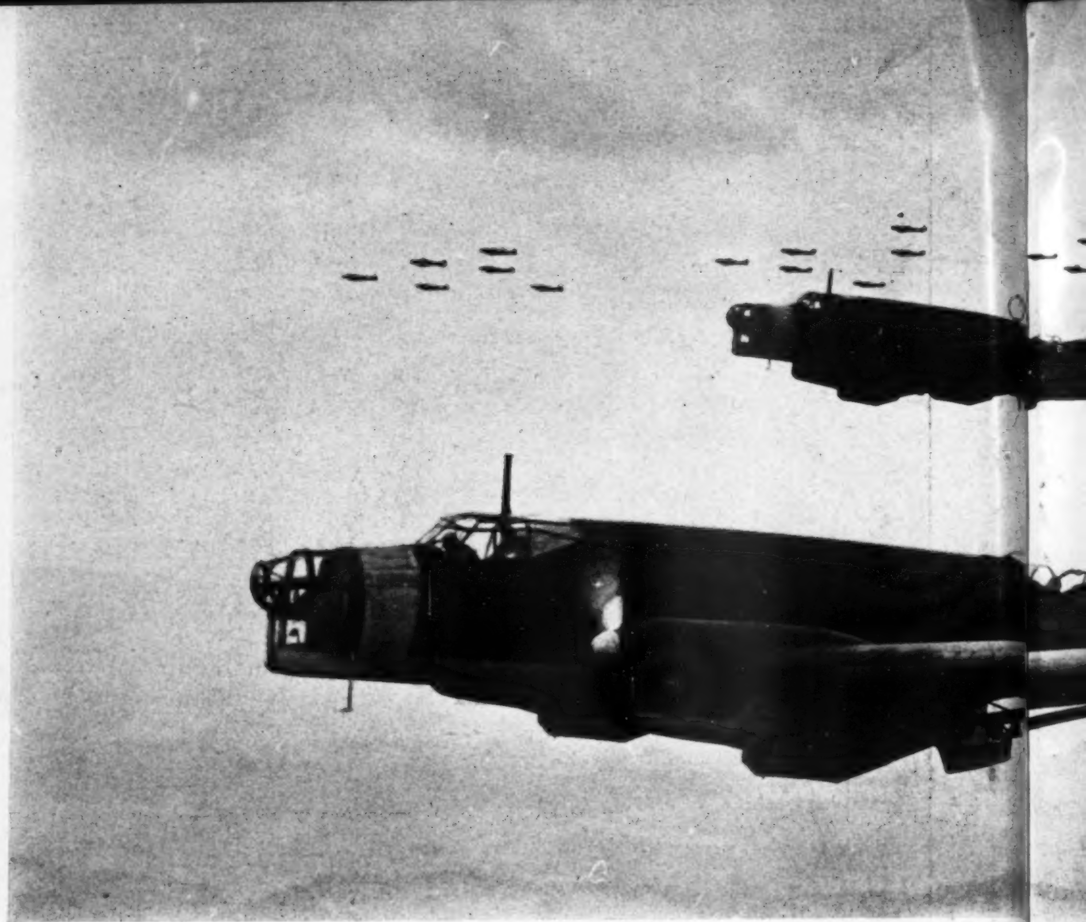
Below — A Brown six-point pyrometer is mounted in the foreground on the exhaust manifold side of the engine room. At the extreme right appears part of the switchboard.





DIESEL AVIATION IN 1937

By PAUL H. WILKINSON



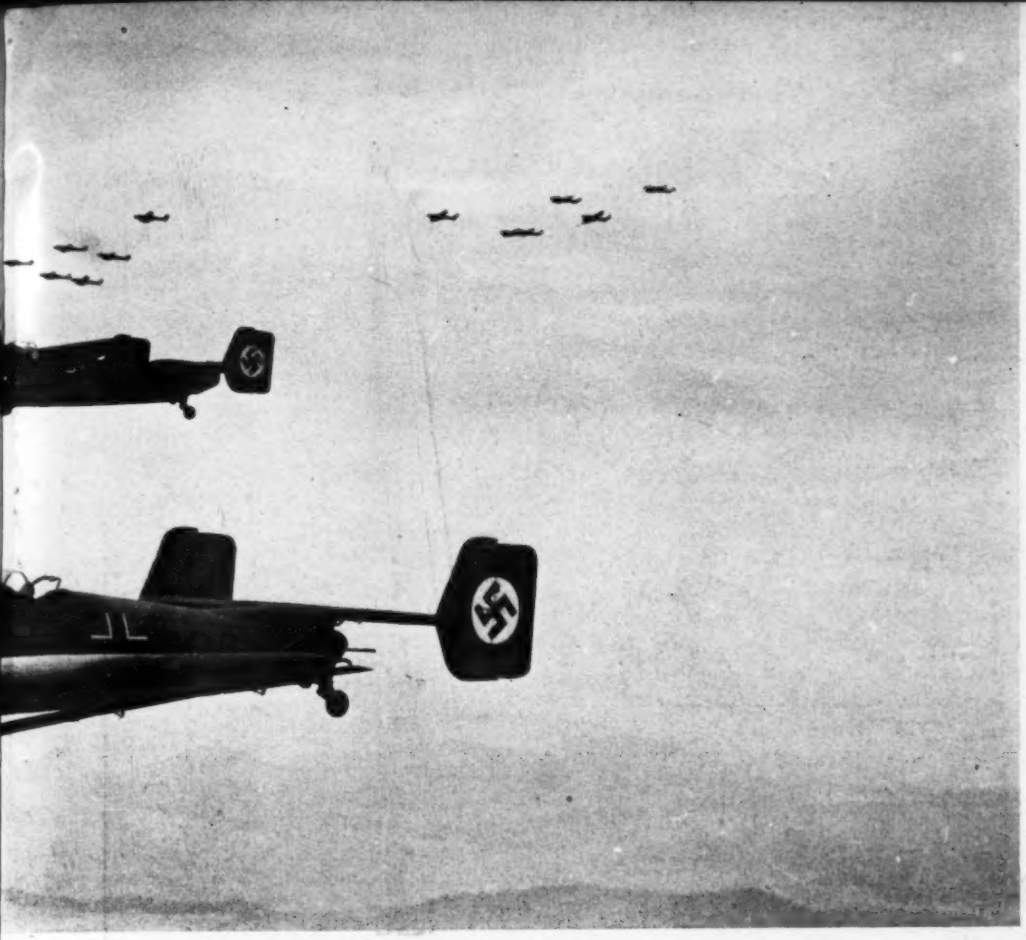
DURING the past year there were few, if any, sensational achievements in Diesel aviation. The activity shown was more in the nature of a well-ordered growth from the successes of 1936 when the Diesel first took its place in extensive airline operation. Included in this growth were the placing in service of many twin-engined transport planes on the airlines of Deutsche Lufthansa, the completion of vast numbers of twin-engined bombing planes for the German Air Corps, and the conclusion of the second series of transatlantic survey flights. To this must be added, the substantial increase in power obtained from the Diesel and the completion of a 1,000 hp. engine which is to appear in 1938.

These activities took place in Germany which alone of all the countries producing aircraft engines during 1937, had the foresight to actively encourage the use of the new type of engine. Little progress was made in other countries, not because pioneers were lacking but because of the insuperable difficulties placed in their way by their governments which through short-sightedness or other commitments, failed to allocate adequate funds for the development and more important still, the *production*, of the aircraft Diesel.

Growing interest in the Diesel for aviation was shown, however, in a number of countries. One understands that the Junkers *Jumo 205* is no stranger in Japan, where fuel economy is of importance; and that the Mercedes-Benz Diesel found favor in the U. S. S. R., particularly for lighter-than-air craft. Italy's close alliance with Germany undoubtedly laid the foundation for the manufacture of the latter's Diesels in Italy, which also has its fuel problems. Great Britain and France, on the other hand, were so involved in tremendous rearmament programs that apparently they had little time other than for the mass production of gasoline engines. The United States in the midst of its abundance, with no particular need to compete in an armament race, once more turned a deaf ear to those who advocated the production of the Diesel for our National Defense.

The illustration at the head of this article is both instructive and at the same time constitutes a warning to American aviation experts, not to put all their eggs in the same old basket. The squadron of twenty-seven Junkers *Ju 86-K*

Diesel-engined Deutsche Lufthansa planes attained the highest speed across the North Atlantic during the international survey flights last year, with a cruising speed of 170 mph.



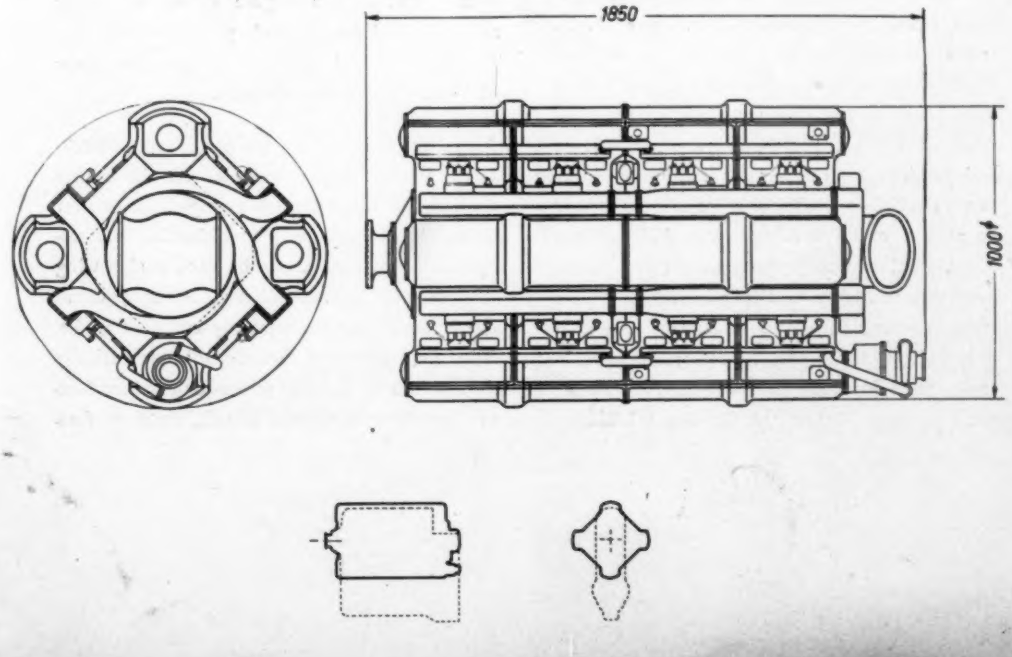
Battle Squadron 254 of the German Air Corps during maneuvers at Nürnberg. Each of the Junkers Ju 86-K fighter-bombers is equipped with two "Jumo" 205 Diesels.

How the Junkers "Jumo" 205 is mounted in the wing of the Hamburger Ha 319 seaplane. The cowling can readily be folded back to facilitate speedy and efficient servicing of the engine.

fighter-bombers, all equipped with *Jumo 205* Diesels, represents a mere fraction of the multitude of Diesel-engined craft now in military service in Germany. With new types of *Jumo* Diesels coming out, it is only logical to conclude that it will not be long before the lightning-fast fighting planes and the immense bombing planes of their ultra-modern air force will also be Diesel-equipped.

The second series of Deutsche Lufthansa survey flights with catapult planes across the North Atlantic comprised seven round-trip flights, the fastest crossing between New York and the Azores being made by the *Nordwind* at a speed of nearly 170 mph. It is said that the four-engined *Ha 139* seaplanes, built by Blohm and Voss of Hamburg and equipped with 600 hp. *Jumo* Diesels, achieved higher average speeds than the much more powerful flying boats of Pan American Airways and Imperial Airways which also did some transatlantic flying. Based on the speeds attained last year, the 5,300 miles between New York and Berlin should be covered in about 30 to 35 hours flying time.

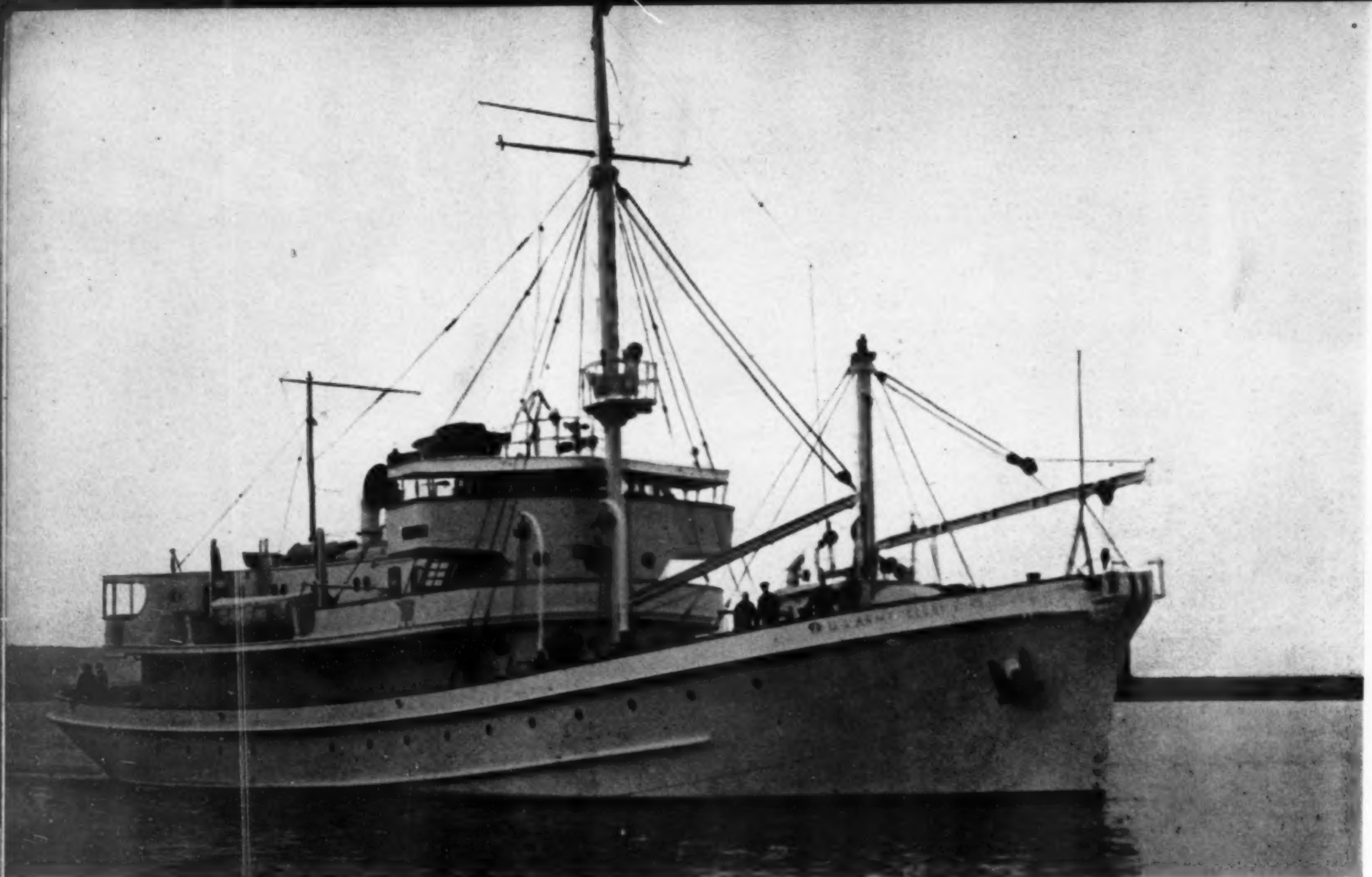
Outline of the extremely compact 24-cylinder Junkers Diesel which is to develop 2,000 hp. for a weight of 1 lb. per hp. It is no larger in size than the earlier "Jumo 204" of 750 hp.



With regard to new engines, the latest Junkers Diesels are still on the restricted list and particulars of them cannot yet be made public. It is generally known, however, that the 1,000 hp. engine has been under test for some time, and that turbo-supercharging to an altitude of 6,000 meters (19,685 feet) is required by the German Air Ministry. Putting two and two together, therefore, it can be stated that although it has not yet made its first public appearance, the Junkers *Jumo 206* of 1,000 hp., turbo-supercharged to 20,000 feet, undoubtedly was the outstanding achievement in Diesel aircraft power plant development in 1937. In the larger engine field, the twenty-four cylinder design for a 2,000 hp. Junkers engine is unique. To weigh only 1 lb. per hp. and have a frontal area of about 10 sq. ft., this much-needed engine is now under development – perhaps for 1939 production.

APOLOGIES TO DAIMLER-BENZ!

In the aviation article in the December issue of DIESEL PROGRESS (page 50), it was stated in error that the new Junkers *Ju 90* transport plane, *The Great Dessauer*, was equipped with Junkers *Jumo 211* gasoline engines. On this particular plane, the first of its kind, four Mercedes-Benz *DB 600* gasoline engines of 950/1,000 hp. each are used. Incidentally, it was with one of the latter engines that the 379 mph. landplane speed record, and the speed of 314 mph. over a distance of 621 miles with a load of 2,205 lb. by a twin-engined bomber, were achieved in Germany.



U.S. ARMY MINE PLANTER "ELLERY W. NILES"

By EDWARD A. HODGE*

THE first ship of its kind ever built, the *Ellery W. Niles,* is a combination mine planter and cable layer. Due to this highly specialized service, two principal objectives were sought. First the ability to maneuver most efficiently at slow speeds, and secondly, maximum control of the ship directly from the bridge. The instantaneous response offered through direct current, Diesel-electric propulsion resulted in the selection of this type of power. This choice has been amply confirmed by the ship's performance which has exceeded all expectations.

**Editor's note: This ship was designed in the Quartermaster General's Office, Washington, D. C., by Edward A. Hodge, New York Naval Architect, serving in the capacity of Supervising Constructor, who was later in charge of the vessel's construction and machinery installation at the yard of the Pusey & Jones Corporation, Wilmington, Delaware.*

Principal dimensions of the vessel are as follows: L.o.a., 185 ft., beam 35 ft., depth 17 ft. 3 in., mean draft 10 ft. 6 in., with a displacement of 1,200 tons. Twin-screw propelling motors are of the single armature type, each rated at 560 shaft horsepower, at 220 rpm. Independent blowers supply induced ventilation of 4,000 cu. ft. per minute to each motor or a total of 8,000 c.f.m. The shafts of the four-bladed cast steel propellers carry Kingsbury thrust bearings and rubber outboard bearings. Current for these propelling motors is supplied by three 600 hp., 6-cylinder, four-cycle, solid injection Diesel engines built by the Cleveland Division of the General Motors Corporation. The port and starboard Diesels each drive one 300 kw. single armature 250-volt generator and one 100 kw., 125-volt exciter. The center engine drives a double armature 300 kw. 125-volt generator and one 100 kw., 125-volt exciter. All generators are of Westinghouse manufacture.

Propeller control is effected at the main switchboard in the engine room or on the bridge through the operation of a single change-over lever. There are three combination control-and-telegraph stands, one on each bridge wing and one in the wheelhouse, all mechanical movement being conveyed by common shafts. Luminous signals on each control automatically show which of the five generator combinations are cut into the main circuit, so that deck

officers always know the percentage of power available to the propellers.

Bridge controls may be used as telegraphs by means of transmitter contacts which serve to illuminate repeater sectors mounted within propulsion control wheels on the main switchboard. Main bridge and engine controls serve to vary the intensity and direction of the main generator field excitation which makes response instantaneous at the propellers to give the maximum maneuverability which is so vital to this vessel in service.

In addition to the three main Diesel engines, there is also a 90 hp. auxiliary Diesel generator unit. A single wheel on the main board cuts in separately excitation current up to 5 kw. from any of the three 100 kw. exciters on the main engines or the 60 kw. auxiliary generator All auxiliary power sources can be cut-in in parallel except for excitation.

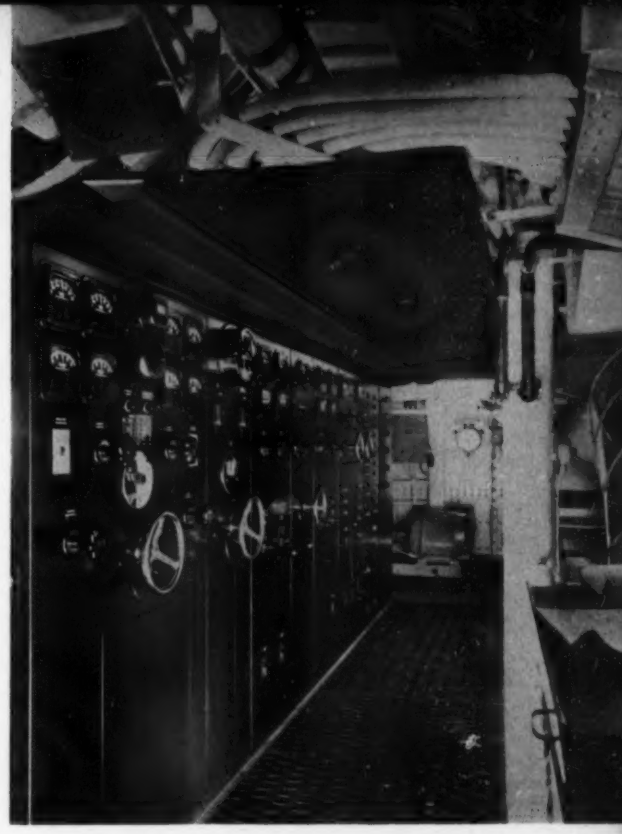
Engine room and deck auxiliaries are electrically driven by 125-volt direct current except the main communication reel. The main cable reel is 10 ft. in diameter with a capacity of 20 tons at 100 ft. per minute through two water tight 75 hp. Diehl motors geared to the main drum with a ratio of 72 to 1. These motors operate on 250 volts from either of two main generators and are controlled by varying the intensity and direction of generator field excitation. Current transfer is accomplished through a single wheel on the main switchboard.

Alternating shore current can be connected through three outside plugs on each side of the ship. Thus 115-volt AC single phase, 250-volt AC single phase and 250-volt AC three phase current can be provided for illumination and power for "dead ship" use through fool-proof set-up switches, a 15 kw. motor generator set and 36 kva. transformer.

Auxiliary equipment for the Diesel engines is worthy of note. There are two Sharples centrifuges of 100 gph. capacity at 9,000 rpm.. one for lubricating oil and the other for fuel oil. The Purolator oil filters, coolers, etc., are installed in triplicate and are connected for independent or combined operation. Each engine has its own gauge board to indicate revolutions per minute, lubricating oil and fuel oil pressure, air pressure, etc., with a central station located at the forward log desk where Brown pyrometer readings from 24 exhaust points are registered on one electric scale and thirty-four fluid temperature readings are indicated on a Twing electric thermometer scale through selector switches. Other engine room pressures are shown on gauges on the same board. Three air tanks, each with a capacity of 100 starts for the prime movers at 350 lb., are located under the machinery flat and replenished by a two-stage Ingersoll-Rand compressor, automatically controlled. A reducing valve cuts down pressure to 125 lb. for the ship's low pressure air system which can be replenished by the whistle compressor.

The 90 hp., 6-cylinder auxiliary Diesel generator set located on the machinery flat is used for standby power when the prime movers are shut down. Soundings for each fuel oil tank are effected through direct reading Pneumericator gauges. All four Diesel engines are equipped with Vortex spark-arrester silencers on their exhausts.

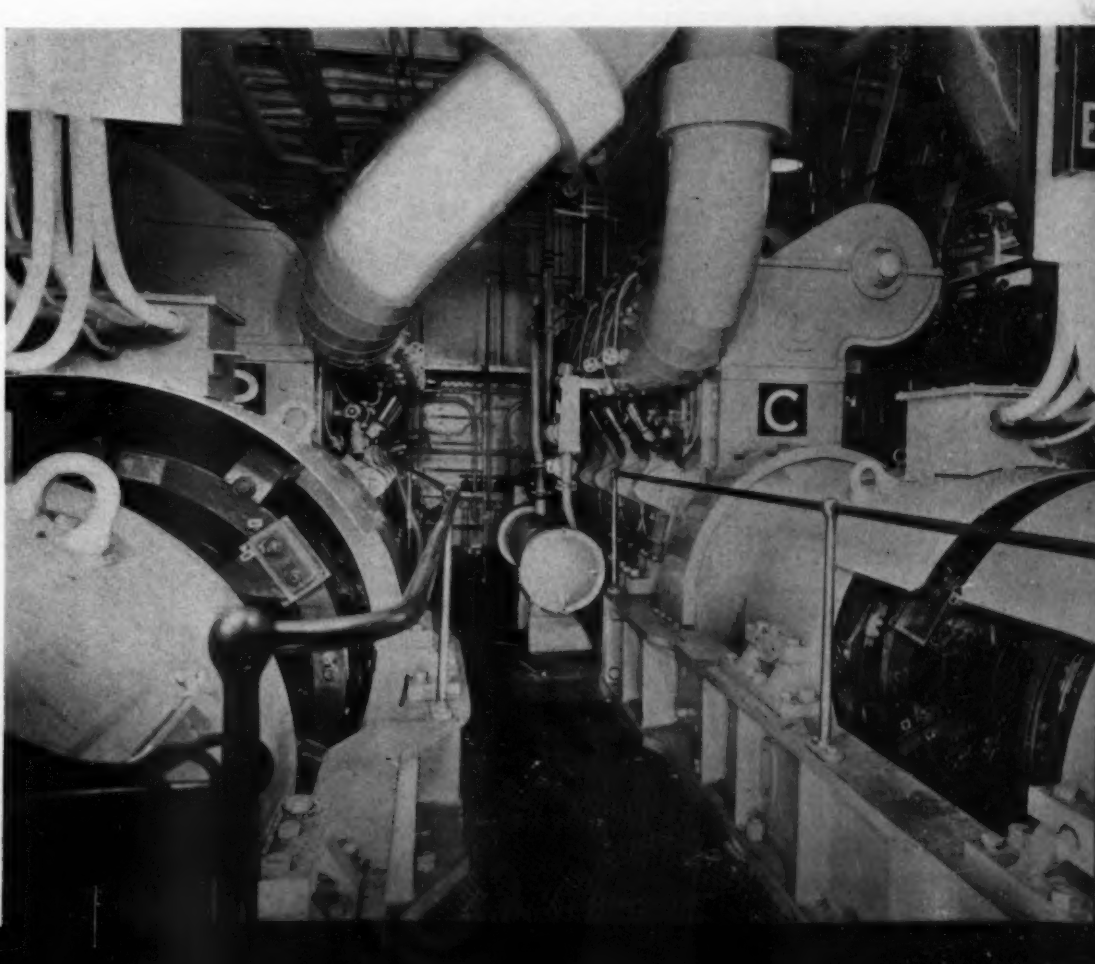
Special appliances include a Submarine Signal Company fathometer with a range of 31 fathoms, Sperry Gyro compass with a master compass on the upper deck connected to seven repeaters: one on top of the wheelhouse, one in the wheelhouse, one on each bridge wing, one in the master's cabin, one in the radio direction finder and one in the engine room. Electric tachometers are installed in the wheelhouse, on each bridge wing, on the after upper deck, on the main switchboard and on the cable control house. Barring the loud speaker system, which will be discussed later, other equipment is of the same general type found on vessels of this kind.



The Westinghouse switchboard on this Diesel-electric vessel is a vital factor of her successful operation.

The *Ellery W. Niles* has been assigned to the Coast Artillery Corps for operation by military personnel and her function is to plant submarine mines which are electrically detonated from coastal fortifications defending rivers and harbors. For the U. S. Army Signal Corps the vessel will lay and repair submarine communication cable. Her permanent station will be at Fort Mason, San Francisco, California,

Main engine room view showing two of the three main propulsion General Motors Diesels driving Westinghouse generators.

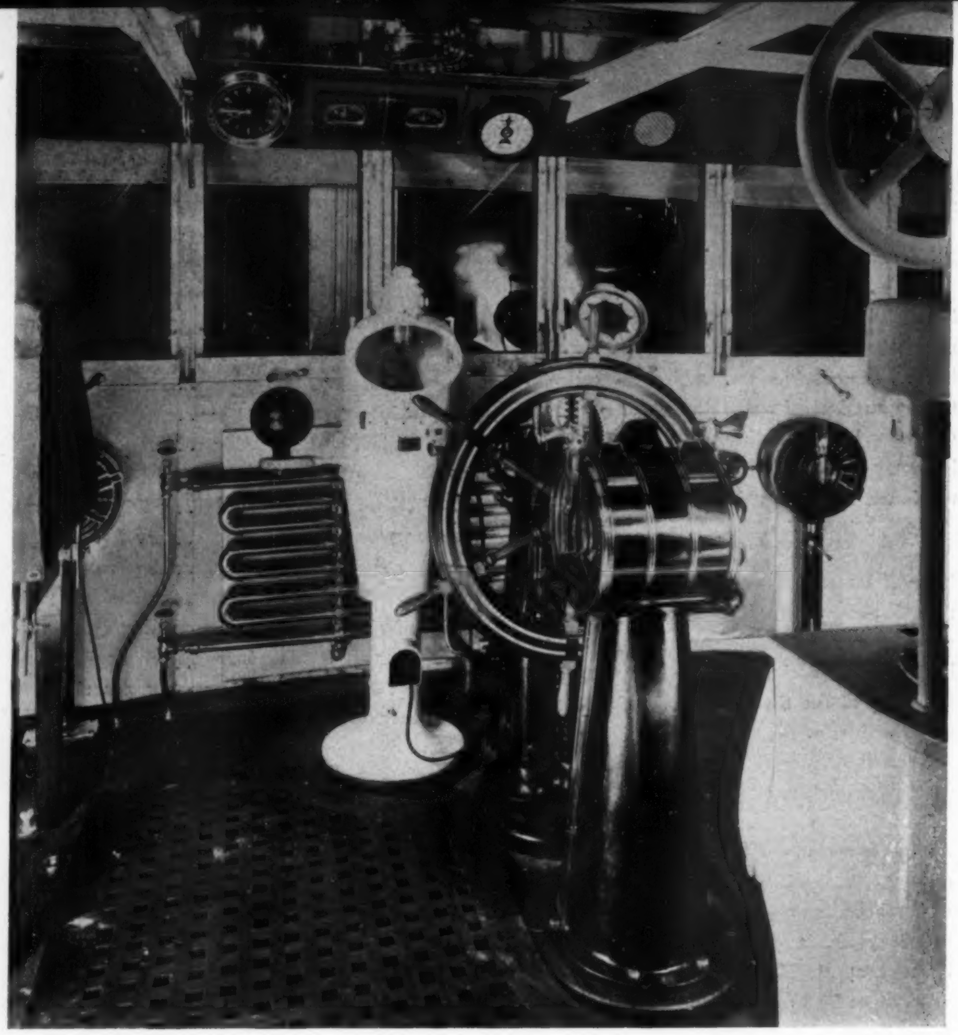


whence she will proceed after the current two months' shake-down cruise, which will include mine planting, cable laying, cargo and passenger carrying, and all other functions contemplated when she was designed.

Engineer officers who visited the ship were particularly interested in the versatility of power selection and were impressed by the fact that only one of the three prime movers has to approach a full power load at any time. In other words, only one of the 100 kw. exciters has to assume the auxiliary load, leaving only a 75 per cent Diesel load on the other two main engines when running at full ship's speed. This makes for lower maintenance cost and allows unusual flexibility. The present exciter capacity anticipates the installation of additional mine handling gear and auxiliaries at a later date.

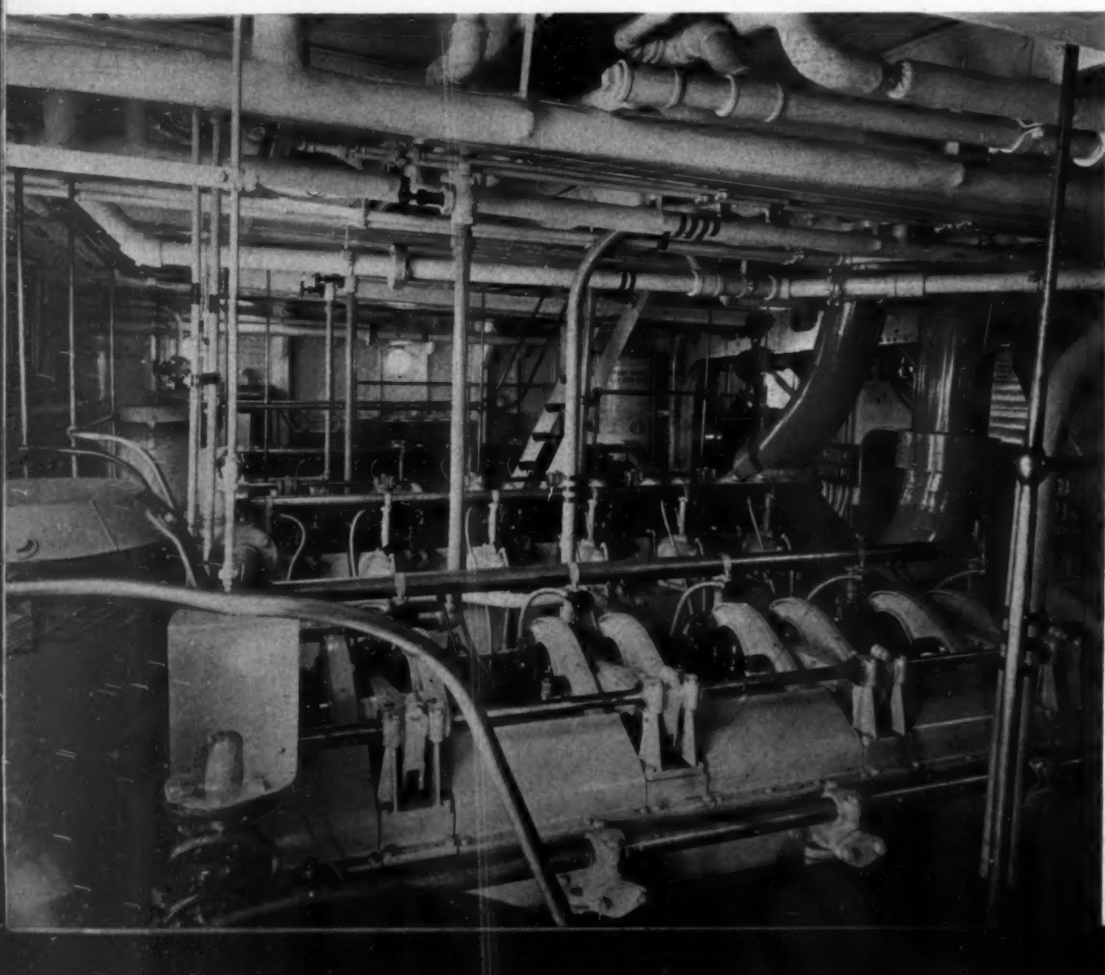
The thirty-five foot beam of the vessel offers greater deck space for handling mine gear than has been heretofore attempted and the electrically operated and remotely controlled communication reel points to a facility in cable handling equal to that of vessels in the Army's fleet built exclusively for cable laying.

The loud speaker system aboard this ship is the first of its kind ever installed and deserves special mention. Built by the Guided Radio Corporation of New York to special specifications, it consists of a seventeen-station two-way communication system with selector switch located under the deckhead over the steering wheel in the pilot house. This makes possible intercommunication throughout the ship by selected circuits in such a way that at no station, except in the engine room, is it necessary for a man to stand nearer than 20 ft. from the speaker to carry on a two-way conversation with the bridge. The speakers act as microphones. In fact, a lighthouse keeper was hailed from the forward deck speaker at a distance of 700 yards and his voice was clearly heard in the wheelhouse speaker and a substantial conversation followed in which both parties thereto lowered their voices without detrimental effect. The same thing was demonstrated at the War College in Washington where ranking Army and Navy officers tried the same experiment. Shipboard use of speakers heretofore has been confined to installations required by law for general emergency use but this is the first 100 per cent intercommunication loud speaker equipped ship. The circuit is of special value on a military vessel since it is of the double impedance type with alternate voice path wires well separated so as to minimize decommissioning the equipment through shell fire or collision.



Wheel house of the "Ellery W. Niles."

The builders, The Pusey & Jones Corporation of Wilmington, Delaware, made a noteworthy effort to cooperate with the designer in effecting an interior and exterior thoroughly in keeping with the desire to make a work boat smart, handsome and modern looking in its many unique features and succeeded so well that opinion seems unanimous that the ship's appearance is most distinctive.



Valve gear of the main engines on Mine Planter "Ellery W. Niles."

DIESEL ENGINES FOR DRILLING OIL WELLS

By JOHN W. ANDERSON

THE drilling of oil wells becomes a more and more complex problem as time goes on, because the tendency is to explore deeper regions of the earth. It is natural under such circumstances for all of the little problems connected with the drilling operation to become more difficult, and the entire process requires more power. The fact that Diesel engines are being used increasingly for this service merits attention to the subject to bring out the reasons.

But before getting into a discussion of the use of Diesels for the drilling operations themselves, it is worth noting that much advantage has been taken of Diesel performance in connection with the preliminary preparations for drilling and for the construction work that follows the finding of oil.

The quest for oil knows no geographical limitations, and when the investigations of the geologist indicate that oil will be found in a certain location, it is there that the first wildcat well is drilled. Occasionally, it happens that such a well is drilled near a city and where transportation for the equipment and power for drilling are readily available. But usually it happens that the drilling location is decidedly removed from any usual trails of civilization, and the first problem becomes one of transporting the needed equipment. The intervening country may be rough and mountainous, it may be a swamp, and in addition it may be wooded, but the drillers must get through it and clear a space for the drilling machinery.

The usual procedure is to load everything onto trucks or trailers or skids, depending upon the weight and size of the individual pieces, and haul or drag them overland. The more difficult the going, the more likely it is that a Diesel powered tractor will be used for the motive power. There is no stopping these machines, and their fuel economy is an advantage not to be overlooked. The less fuel they burn, the longer haul they can make on a single tank filling and the smaller the quantity of fuel that must be hauled independently to keep them going. The savings in fuel cost are also appreciable in most cases.

Once on location, there is further heavy work to be done. The ground must be cleared and graded; perhaps tree stumps must be pulled. The drilling equipment must be spotted, and this is a major job in itself. The slush pits must be dug. In all of these operations, the Diesel powered tractor, winch and derrick, and the bulldozer, play an important part. The same arguments again hold for the use of the Diesel engine for this work—namely, that it gives dependable, hard pulling power on a small quantity of fuel, and at low cost for fuel and other items.

Then comes the drilling job. There are three important phases or power requirements for this: driving the rotary drilling tool, driving the slush pump, and handling the drilling tools and casing in and out of the hole.

The first of these requirements needs a steady flow of power for rotating the drill, and the power needed varies with the character of the ground through which the drill happens to be passing, and with the depth of the hole. Of the three phases of drilling, this item calls for

Figure 1 (right): A Fairbanks-Morse two-cycle vertical Diesel furnishes power for this rig.

Figure 2 (bottom): The Southwest Drilling Company's rig in the Taft field near Corpus Christi, Texas, uses two Caterpillar Diesels.

the smallest power output of any and the speed is practically constant.

Driving the slush pumps is a steady grind at constant speed, but with considerable power required. As the mud from the slush pits is circulated through the drilling tools and the hole to clear it of the chips and debris cut away by the drill, the pressure required for the process varies with the depth of the hole for the most part. But sometimes the passages get plugged or nearly so, and in order to clear them it is necessary to increase the pressure developed by the slush or mud pumps in order to literally blow out the plug. Sometimes the two mud pumps are even compounded to double the pressure for this purpose. All of this, of course, throws an extra load on the source of power driving the pumps, and perhaps even a heavy overload. Moreover, there are likely to be many shocks on the pump and its driving power source during such manipulations. Thus this part of the duty is heavy and continuous, even severe at times.

The third phase, that of handling the drilling tools and casing, is a variable speed and variable load job. When the hole is shallow during the early stages of drilling, the weight of the parts is not great and the power requirements are modest. But as the hole gets deeper, the equipment to be handled increases and the power needed becomes large. In fact, the power for this phase is usually the greatest of any of them. There is an added difficulty in this connection. The string of tools or casing must be put into motion and stopped reasonably gently, yet to save time it is desirable to move them rapidly while they are in motion. Sometimes the tools or casing get stuck in the hole and require considerable extra pull to get them started. All of this calls for great pulling power and smooth positive control in addition to variable speed. Much ingenuity has been shown by the designers and builders of drilling rigs in meeting the severity and multiplicity of these requirements and in adapting various sources of power to this phase of the operations.

There are four sources of power for this sort of activity: electricity, steam, natural gas engines, and Diesel engines.

Electricity is seldom available because, as already explained, these wells are seldom located near any such source of power. And even if it is available, there is always the question of cost. There is no doubt of its great convenience and simplicity of use, but the cost of it must be low enough to make a favorable comparison with its competitors.

Steam power has been widely used for this purpose and the details of its application have been highly developed. It is not feasible to employ very high pressures in this work, nor can the engines or turbines be run condensing readily. The inevitable result is inherently poor thermal efficiency of performance that is reflected in operation of the plant by the high fuel consumption and large demand for boiler feed water. Such a plant permits a choice of fuel — wood, coal, natural gas, or fuel oil, according to what is most convenient and the cheapest in any given case. Some of these fuels may be available locally and at a reasonable price when a well is being drilled in or near a proven oil field, but rarely or never when wildcatting.

Hence, in most cases, it is necessary to haul every bit of fuel and supplies needed for the drilling plant from a distance to the drilling location. Naturally the drilling contractor will choose a source of power which means the smallest quantity and the lowest total cost. Since good boiler feed water is nearly always difficult or even impossible to obtain locally in sufficient quantities, this item is usually a major problem in haulage to the site of the operations. It is just one more count against the use of steam power for drilling purposes.

Natural gas is a convenient and frequently

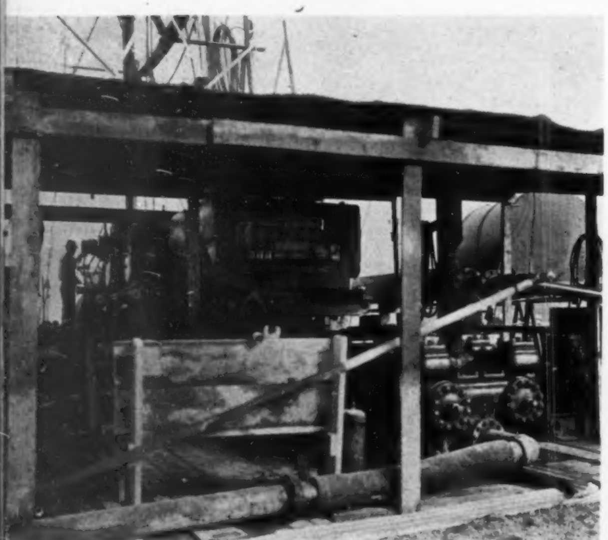


Figure 3 (left): A pair of Caterpillar D-13000 Diesels operated by Helmerich and Payne in the Beamis field, Kansas.

Figure 4 (lower left): Two six-cylinder, two-cycle Fairbanks-Morse engines at Oklahoma City are engaged in drilling to a depth of 6,500 ft.

Figure 6 (below): A pair of the 200 hp. each Cummins Diesels owned and operated by the Noble Drilling Co.

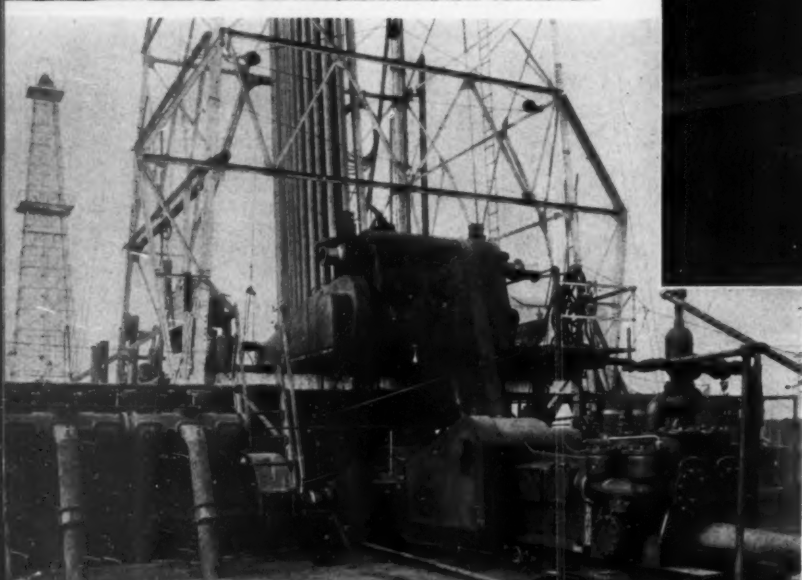


Figure 5: Four Caterpillar Diesels are compounded in pairs to handle draw works and slush pump in this rather unusual drilling operation.

cheap fuel to use, but how often can this fuel be found nearby? In a proven field, there may well be a supply available. In such cases, there are natural gas engines that will give good, dependable, efficient performance. In fact, many manufacturers build convertible engines for this sort of service. A few hours' work and a few parts changed, and the engine can be made into a natural gas engine or a Diesel engine. This enables the owner to take advantage of local fuel situations and adjust his operations for the greatest convenience and economy.

The Diesel engine is the most flexible of all in its application because it has the highest thermal efficiency of all and hence uses the smallest quantity of fuel for the work done, because it requires only a small quantity of makeup water for the losses in the engine cooling system, and because it is the most completely self-contained power plant easily transported and set up in a new location. Of course, it must also give a cost of power that is competitive or lower than from other types of units, but usually fuel oil is available at a low cost, and combined with its efficient use, the overall cost of power is low. So it appears that the reasons why the Diesel engine has attained such wide favor in oil well drilling are the convenience, flexibility of application, and economy in operation.

Diesel engines of various types and numbers of cylinders have been employed for this service. They have been successful because they were properly installed and suitably rated for the load conditions. In spite of the adverse operating conditions, they have done their duty. But these service conditions are no place for engines which are not built to take heavy loads or which are delicate and need sensitive treatment.

The accompanying pictures show many Diesel drilling installations, and how the engines were arranged to drive the machinery. They give a clear idea of the severity of the operating conditions and of the variations in details of installation to make the engines adaptable to the particular installation conditions. Notice that in some cases the machinery, including the engines, is installed out of doors, where it is exposed to the dust and the weather, yet it must perform normally. Continuity of service is an important item in these drilling operations. It is expensive to maintain machinery and men on such a job, and any lost time due to breakdowns is serious. Furthermore, wells are sometimes drilled against time to get to the oil in the ground before some neighboring rig gets there.

In Fig. 1 there is a general view of a steel derrick with the drilling machinery around its base and the drill pipe stacked inside of the derrick framework. There is a working platform built into the derrick a short distance above the ground level, while the Fairbanks-Morse Diesel engine of the vertical two cycle type with the horizontal slush pump can be seen on the ground at the right of the base of the derrick. Beyond there is the cooling tower for the engine cooling water system, and back of that is the fuel oil storage tank.

The Southwest Drilling Co.'s rig in the Taft field near Corpus Christi, Texas, is shown in Fig. 2. There are two Caterpillar engine units mounted on the platform adjacent to the draw works. During the drilling operations, the engine at the right drives the rotary drill table, while the engine unit at the left drives the mud pump on skids on the ground through the V belt drive shown. When handling the drilling tools in and out of the hole, the two engines are compounded for driving through the draw works. Such an arrangement provides ample power for all three phases of the drilling operation, with a minimum of engine power and units. Notice the portability of such a machinery setup, and each engine unit is a complete power plant in itself with its own cooling system. Once the engine is spotted in place and bolted down, the only outside connection to be made is the power takeoff.

A very similar layout, except that the platform is just off the ground, is shown in Fig. 3 with two D13000 Caterpillar power units. The operator can be seen at his position at the controls of the draw works. The pipe in the foreground is the suction line from the mud pit to the pump. At the right of the mud pump is the auxiliary unit on its own skids, and in the background above it is the fuel oil storage tank. This rig is operated by Helmerich and Payne in the Beamis field north of Hays, Kansas, and the records showed a cost for fuel and lubrication of less than 50 cents per hour. No engine repairs were required during the drilling of this well.

Drilling to a depth of 6,500 feet in the new Oklahoma City field, the W. T. Payne Drilling Co. employed the Fairbanks-Morse engines

Figure 7: The Pure Oil Company's Caterpillar units in southern Illinois each operate twelve hours per day, running in two-hour relays with an hourly fuel consumption per unit of four gallons.

rig in Fig. 4. There are two six cylinder two cycle Diesels, each rated at 240 hp. for continuous duty. One engine drives the mud pump at the right, and the other the rotary drill table. But the two can be compounded and develop a maximum of 750 hp. total when acting through the draw works on the platform above for pulling tools. The exhaust pipes from the Diesels are conveniently taken down under the ground to carry the outlets away from the rig.

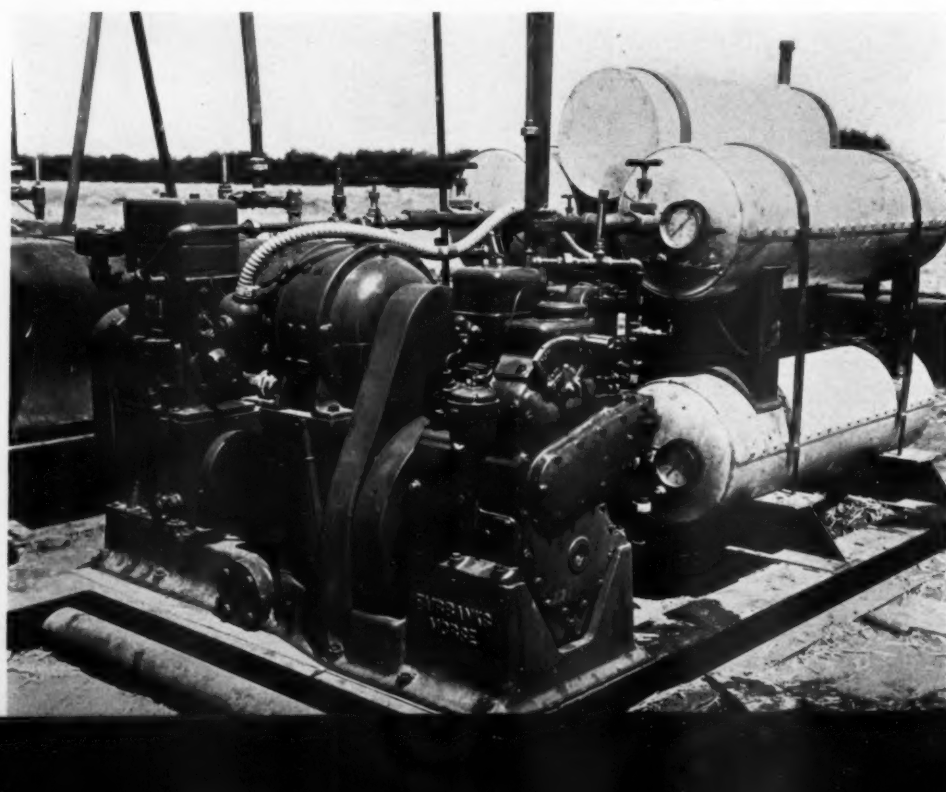
Four Caterpillar engines on one job are shown in Fig. 5. Two D17000 units are compounded for operating the draw works and an 18" mud pump, and are located on the driller's platform. Down on the ground are two D13000 units compounded for driving the 16" mud pump; the end of the latter is in the left foreground. It is quite usual to compound standard sized Diesel engine units this way in order to obtain the required power for the drill rig. All four engines consume a total of about 300 gallons of six-cent fuel oil per 24 hour day. There is an auxiliary hoist engine unit at the right on the driller's floor.

Two Cummins engines, rated at 200 hp. each at 800 rpm., are shown in Fig. 6 drilling a well for the Carter Oil Co. near Wilson, Okla. Normally, the engine in the foreground drives the mud pump through the belts at the left, while the other engine does the drilling. The two engines are compounded for handling the tools out of the hole through the draw works in the background. The friction clutches on the engines and the flexible couplings between the engines and the Allis-Chalmers belt drives are plainly seen in the center of the picture. Notice also the air intake filters mounted on top of the engine manifolds, and the exhaust pipes leading out and upward from the engine headers. There is a cooling tower outside of the shed, and starting air is supplied from a Stover engine driving an air compressor.

The two 125 hp. Caterpillar Diesels, each driving its own mud pump, on a Pure Oil Co. job in southern Illinois are shown in Fig. 7. Each unit is used 12 hours a day, running in two-hour relays, and consumes about 4 gallons of fuel oil per hour. The engine units in all of these rigs are on skids and the foundations are none too massive or rigid; therefore, the engine units must be fairly well balanced and be smooth running.

Most of these rigs have an auxiliary unit, and a good example of them is the Fairbanks-Morse engined unit in Fig. 8. A Model 36 single cylinder 10 hp. four cycle engine is direct connected to the two stage air compressor at the left, drives the 2½ kw. direct current generator at the top of the unit by a V belt, and is clutch connected to a 3 inch rotary wash down pump. Any of this equipment can be disconnected.

Figure 8: This Model 36, 10 hp., single cylinder Fairbanks-Morse is a good example of auxiliary power for driving a generator and air compressor.



Over 2 million feet of gas caused this well near Russell to come blowing in at gusher proportions recently.

RUSSELL, KANSAS

By J. F. BRANSON, *Supt. of Municipal Utilities*

THE romance of the west is written in the history of Russell, Kansas. Old-timers still recant Indian forays, when the corner meat market was the thundering herd on elusive hoof, and the day when the only law was a lightning draw. Long, hard winters bred a generation of hardy pioneers who spun a living through long hours of productive toil from the bare earth, in cattle and then, wheat. And now, these pioneers and their succeeding generation are gazing upon the wealth of black gold — oil. Russell, Kansas, in the past three years or so, emerged from just another community to a thriving and growing petroleum plains metropolis.

As measured in terms of time, the city's electric utility development commenced only yesterday. The tallow taper and kerosene lamp gave way to electricity in 1911, twenty-six years ago, when the first De La Vergne Diesel engine generating unit was installed. This was a 125 bhp., single cylinder, air injection, horizontal engine, long since replaced. In 1915, an additional De La Vergne Diesel engine, a 100 bhp., single cylinder, horizontal, solid injection unit, was installed. This engine was also removed in 1934, because of increasing plant load impositions. In 1921, a 200 bhp., 2-cylinder, horizontal, solid injection De La Vergne unit was added to the plant.

This was followed in 1929, by a 550 bhp. vertical, five-cylinder, solid injection Diesel; in 1934, by a 1,000 bhp. vertical, eight-cylinder Diesel; in 1936, by a 1,600 bhp., eight-cylinder, 22 in. x 30 in. bore and stroke, engine. During the past twenty-five years, six De La Vergne engines, representing a total of 3,575 bhp., have been installed. At present, the plant has completely outgrown the 200 bhp. unit which will be removed shortly.

This growth of the municipal electric plant generating capacity has been due to oil drilling and development in the county the past three years. A few producing wells are located within the city limits. In the country, new oil pools are constantly being brought in. New well locations are being staked and it is expected that a continued intensive drilling operation during the next few years will add further to tax the facilities of the city. The population has doubled overnight. New homes are springing up in all parts of the city to house the influx. The expanding business section is a beehive of activity. Oil field supply houses, with attendant machine shops and material yards are conspicuous everywhere. The past year, fifteen of the business establishments and homes were air-conditioned. The present year will add greatly to the number.

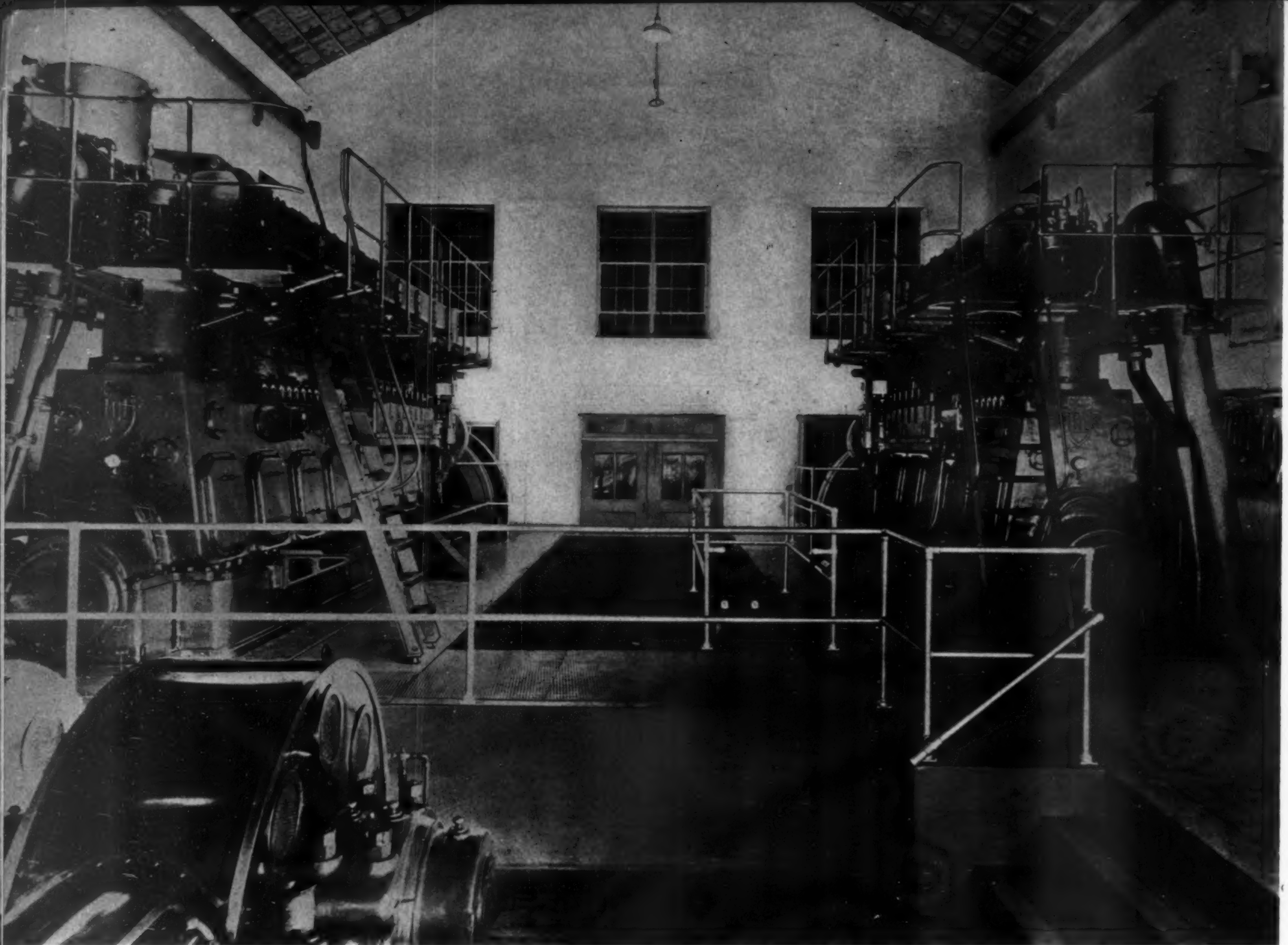
ELECTRIC CUSTOMERS GROW

The plant records show the following number of electric customers:

Year	1930	640	electric customers
"	1933	675	" "
"	1934	720	" "
"	1935	896	" "
"	1936	1,076	" "
"	1937	1,331	" "

Plant production, or kilowatt hours generated for all purposes, has shown phenomenal growth, as evidenced in the following:

Year	1933	1,028,195	kwh. generated
"	1934	1,532,450	" "
"	1935	2,885,690	" "
"	1936	3,888,700	" "
"	1937	5,344,400	" "



An 8-cylinder VA De La Vergne Diesel of 1,000 hp. is shown at left in illustration above, and at right a 5-cylinder De La Vergne VA Diesel of 500 hp.

The increase in production in 1936 over 1933 is 269 per cent; in 1936 over the preceding year, 1935, is 35 per cent. The production for the first five months of 1937, compared with the similar period in 1936, shows an increase of 22 per cent. The average municipal electric plant enjoys a yearly increase in production from 5 per cent to 7½ per cent. This comparison will enable anyone to comprehend the magnitude of the Russell plant operations the past few years.

The plant production for the year 1936, a total of 3,888,700 kwh. consisted of the following load classifications.

Flour Mill	989,100 kwh.	25.4%
Water Works Pumping	492,930 "	12.6%
Oil Field Circuit	447,710 "	11.5%
Power Plant Auxiliaries	202,360 "	5.2%
Commercial Circuit	1,666,000 "	42.6%
Street Lighting	90,600 "	2.3%

About this time last year, the peak load was 725 kw. Today, it has reached 1,050 kw.

The gross revenue of the electric department shows advances, in like manner:

Year 1934	Gross Revenue	$35,907.30
" 1935	" "	60,419.20
" 1936	" "	77,575.69
" 1937	" "	35,316.41 (5 mos. only)

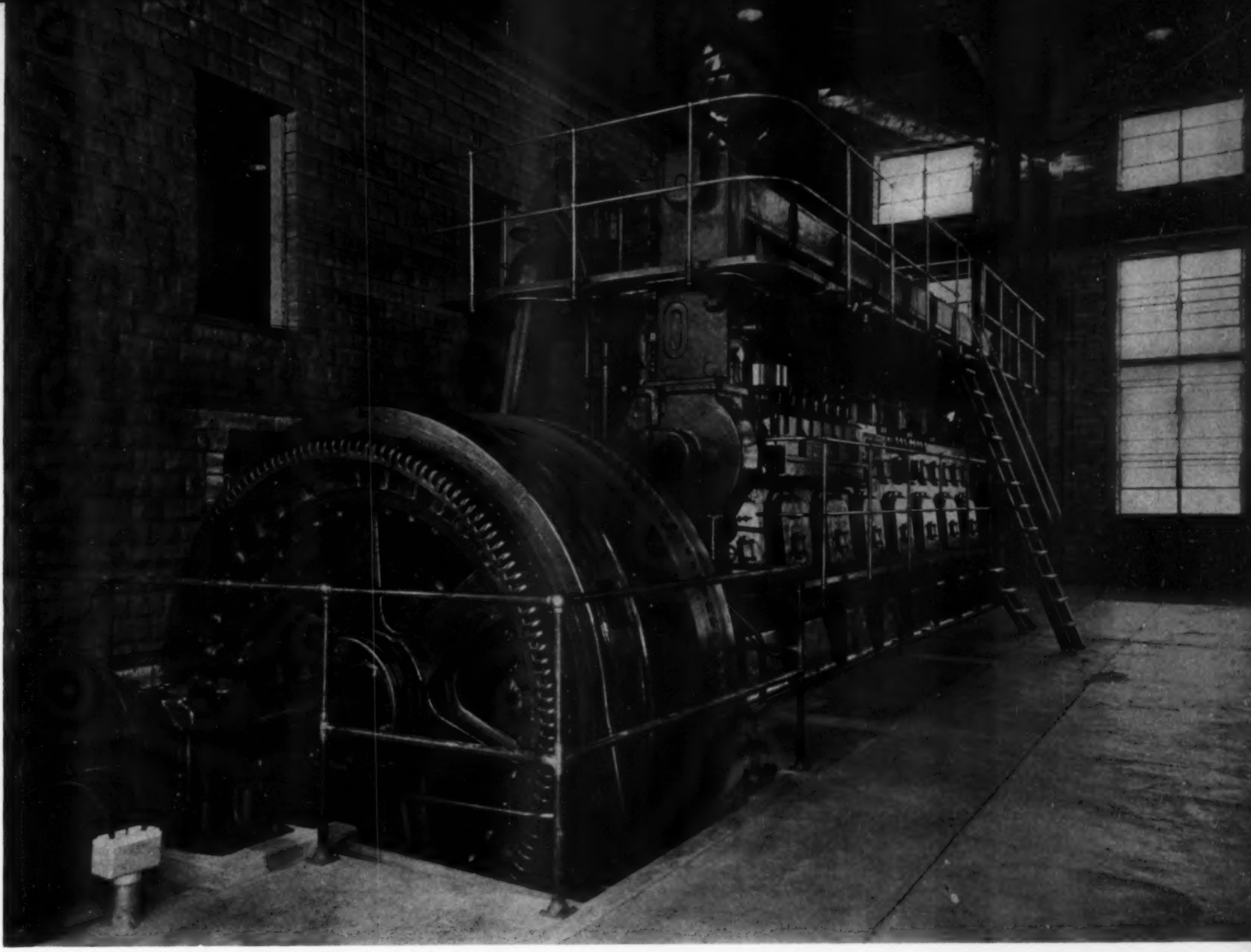
The increase in 1936 over 1934, a two year period, is 116 per cent. The revenue for the first five months of 1937, compared with the corresponding period of 1936, shows an increase of approximately 25 per cent. The gross revenue does not include taxes collected for street lighting.

The city has been served well. The service is excellent and interruptions are rare, if any, which is highly commendable, particularly during the recent past periods of plant and system expansion. Engine performances exceed the fondest expectation. For example, the 550 bhp., 5 cylinder, engine ran 99.6 per cent of the total elapsed time over a five year stretch.

This meant non-stop runs from 2 to 6 months concurrently. In terms of automobile mileage, at an average rate of 35 miles per hour, the engine ran 1,516,875 miles without a forced shutdown, and without a bearing adjustment. No pistons were pulled. The maintenance cost did not exceed $150.00.

In 1934, following the installation of the 1,000 bhp., 8 cylinder engine, the plant undertook to serve electric operated standard cable tool drill rigs for oil well drilling. This service is severe. As noted on the strip-chart from the switchboard graphic wattmeter, during a two hour interval, from 6 A. M. to 8 A. M., the engine was subjected to momentary and heavy load impositions, particularly during the well casing pulling operation. The load imposed erratically approximated 500 hp., or one-half the capacity of the full-load rating of the engine. When these impositions occurred at other hours of the day or night, the total load on the engine would exceed considerably the rating of the engine.

Fuel used in these engines in the past came from a number of sources and the ability of the engines to burn a wide variety of fuel, from the crude in the local fields, to good

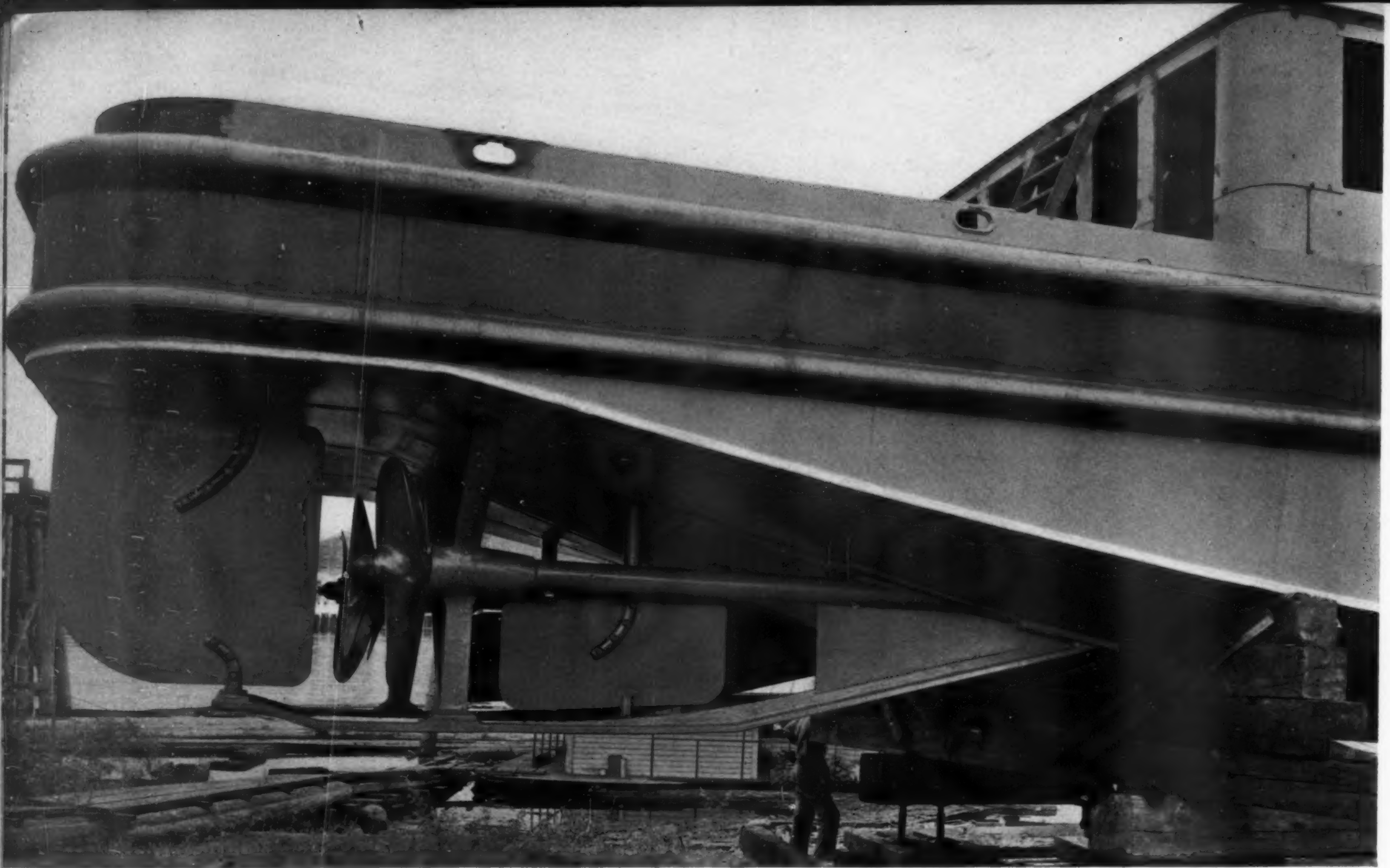


Two views of the huge new 1,600 hp. De La Vergne Diesel engine recently installed in Russell's Municipal Power Plant.

grades of refinery fuel oil, aided materially in not only reducing operating cost, but also removed a hazard of operation. In the year 1936, the plant generated 11.2 kwh. per gallon of fuel.

The installation of the 1,600 bhp. engine necessitated an extension to the power plant building, with space reserved for additional power, if ever required. At the time the last engine was installed, a new and larger closed cooling water system was also installed. Other plant improvements in auxiliary equipment were made. The municipal electric plant of Russell, Kansas, is ultra-modern in all respects; no details have been overlooked.

To keep pace with such heavy demand for electric energy, the past and present city administrations responded splendidly. The result of this vision and forethought in providing for additional power generating facilities is now manifested in the mounting profit of the municipal electric plant's operations which can rightfully vie with the newly found wealth — black gold.



Close up of shallow draft stern design which materially increases the "Patricia's" usefulness in river navigation. Note balanced rudders.

"PATRICIA"

Novel Diesel Tug for Columbia River

By CHAS. F. A. MANN

HAILED as the finest and most unusual Diesel powered tug ever built on the Columbia River, the all-welded steel four-deck tug *Patricia* just completed by the Western Transportation Company of Portland, has gone to work towing barges and logs up and down the Willamette and Columbia Rivers.

Her novel design and ultra-roomy interior layout were the result of adoption of the picturesque Columbia River tradition of having the pilot house at least four decks above the waterline, for wide visibility on all sides, to facilitate handling booms (rafts) of logs in stormy weather or when the river is boiling and churning during flood season in the late spring of each year. The principal small-boat industry on the Columbia and Willamette Rivers in and around Portland is the tugboat business. Hauling of huge barge loads of hog fuel (wood waste and sawdust), long booms of logs, pulp and paper barges and oil tanker barges, between river ports and industrial plants is a busy industry. The parent company of the Western Transportation Company is none other than the famed Crown Zellerbach Corporation with huge paper mills at Oregon City on the Willamette and at Camas, Wash., above Vancouver, and not far from Bonneville Dam. The early days of the Western Transportation Company were largely in the time of the old-fashioned steam stern-wheelers that burned either wood or oil and chow-chowed up and down the river – picturesque but expensive to operate and very clumsy.

Possibly the last great river system in America to take up Diesel propulsion seriously, the operators on the Columbia have literally dropped steam in the past few years and now possess some of the most distinctive Diesel installations to be found anywhere.

The tug *Patricia* was fabricated by the owners on riverside skids, and is 87 ft. 11 in. overall length; 21 ft. 3 in. beam and has a molded depth of 9 ft. 3 in. and a draft of 5 ft. 6 in. By raising the ceiling about two and one-half feet above the deck level, an unusually roomy engine room results, yet the useful feature of having a low deck near the waterline is retained.

A roomy galley equipped with an oil-burning range and a large electric ice box and crews' quarters are located on the first raised level. In the partially raised portion aft of this space is the upper end of the engine room and the large windlass room where the elaborate electric towing winch and cable drums are located. On the third level are roomy captain's and engineer's quarters, while on the fourth level is the small pilot house with plenty of deck space on all sides and clear visibility in a complete circle. The stack is purposely cut off below the level of the windows in the pilot house to give unobstructed view in all directions.

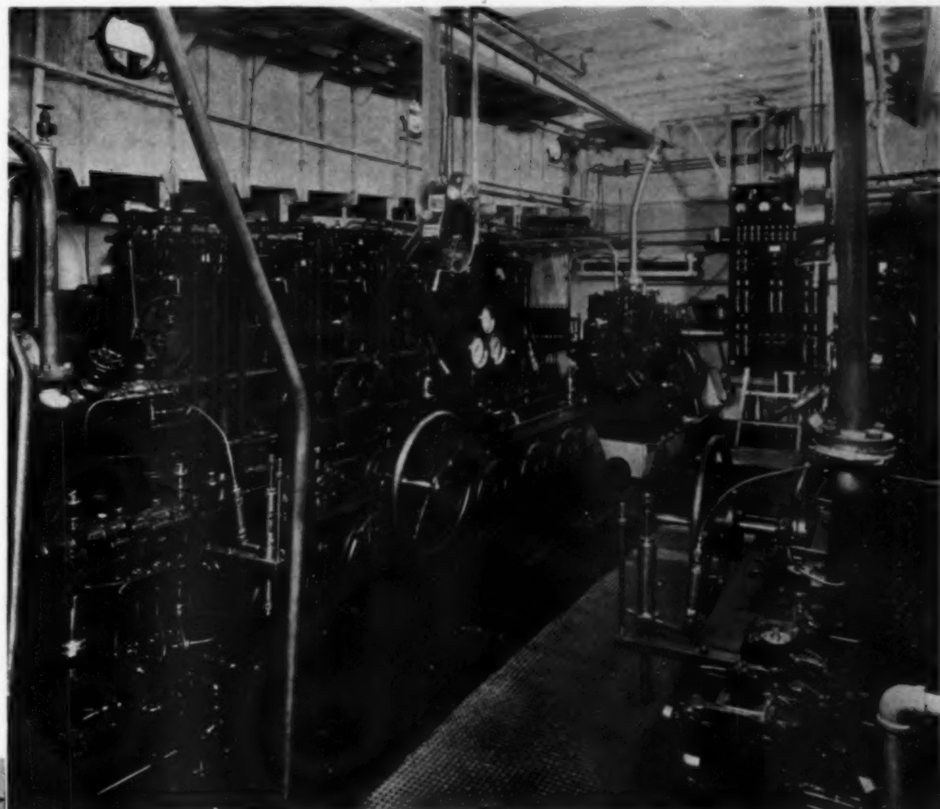
Main propulsion consists of two six-cylinder, 200 hp., direct reversible, Atlas Imperial Diesel engines. The propellers are four-bladed and 60 inches in diameter. The main engines are of the well-known trunk piston Atlas design, with special camshaft moving mechanism and dual air starting valves for quick direct reversing with one control lever. A four-cylinder, four cycle ATIMCO (Atlas) stationary Diesel of 40 hp. is connected to a 25 kw. d.c. generator, which furnishes power for lights, towing winch and the pumps. All of these pumps are of Cameron manufacture and consist of two 1½-inch water circulating pumps for the main engines and Goodrich Cutless bearings in the stern tubes — a main pump and standby duplicate. An important feature of river work is the need for careful handling of the silt-filled river water and the successful lubrication of the stern bearing under pressure, with clear filtered water, to keep out the abrasive silt that would cut the shafting. A special 3-inch pump with 20 hp. motor is fitted for pumping barges, fire service and washing decks. This pump will deliver 400 gpm. at 60 lbs. pressure or 1,000 gpm. with no head, as in the case of pumping barges. Small 1-inch and 1½-inch pumps handle fresh water for cooking and drinking and a combination bilge-sanitary pump complete the layout.

In addition to the 40 kw. generator set there is a 10 hp. single cylinder Atlas Imperial stationary engine with self-contained radiator which drives a 5-kw. generator to handle all ordinary loads when the big pump or towing winch is in operation. A complete electric switchboard controlling all generators and circuits is fitted amidships of engine room. An Arcola oil fired heating system is located in this room also.

The towing windlass is an elaborate affair built by Markey Machine Company of Seattle with a large center drum for handling the steel towing cable through a hollow mast mounted on the roof and aft via a pulley at the top. Smaller drums for tightening barges when hauling them lashed to the sides, instead of strung out aft, are fitted on each side of this main center drum. A 20 hp. G.E. motor is geared to this winch. This room is fully enclosed and does away with having the towing gear exposed on an open deck, aft.

There are four rudders on the ship, a small one mounted just ahead of each propeller and a large one (balanced) just aft, extending to the end of the hull. In motion the tips of the larger rudders are but a few inches below the water line.

The machinery sale was consummated by Mr. A. C. Fries, Portland manager of the Atlas Imperial Diesel Engine Company, and the Western Transportation Company was represented by Mr. L. R. Gault, general manager. The *Patricia* is considered the finest tug on the Columbia River, although not the largest, and is the eleventh unit of the Western Transportation Company fleet of power vessels. The Company also operates twenty-four various other types of floating equipment.



Two 6-cylinder, 200 hp. Atlas Diesels drive twin screws for main propulsion. A 4-cylinder, 40 hp. Atlas (Atimco) Diesel serves auxiliary purposes. Below — The unusual superstructure provides exceptional 360° visibility for the pilot.

Disc plowing sugar cane fields on the Island of Maui with a Caterpillar Diesel 75.

DIESELS ON HAWAIIAN SUGAR PLANTATIONS

By JOSEF REUTERSHAN

THE two previous articles which have appeared in DIESEL PROGRESS on the use of Diesel engines in the Hawaiian Islands have dealt with the application of this type of power unit to isolated electric generating plants, namely, the Busch-Sulzer powered station at Hilo and the Worthington engines at Kealakekua. Wherever one travels throughout the four main islands of this delightful Pacific paradise, Diesels of many types and sizes meet the eye. In addition to stationary generating plants, Diesels are employed extensively in tug boats, tuna clippers, refrigerating plants, ground clearing operations, rock crushing, the pineapple industry and sugar cane plantations. Of all these, perhaps the last demonstrates the remarkable versatility of the tractor type Diesel to the best advantage.

The Caterpillar tractor was introduced in the Hawaiian Islands many years ago and has proven one of the most important factors in the development of the extensive sugar industry. The Caterpillar Diesel tractor made its first appearance in 1931 and there are now approximately two hundred of these economical mobile power units performing the toughest service under as severe conditions to be found anywhere in the world. During the past six

A typical road through a cane field on Oahu, Hawaii.

years they have established themselves with the planters as the most popular and economical units for outdoor tasks requiring great power and flexibility. Diesel fuel oil on the Islands costs only one third as much as gasoline and only about one half as much is required to do the same amount of work, so it is evident that the fuel saving is considerable, particularly where the machines are operated night and day for many months of the year. Quite a few Diesel tractors have records of 6,000 actual work hours in one year.

New uses are continually being discovered for these Caterpillar Diesels and their power is being adapted to plantation work in a manner never dreamed of just a few years ago. Due to the nature of the land, clearing and tillage are particularly difficult. In fact, some of the land is so covered with great boulders that it would seem almost impossible for any machine to get through to remove them. The Diesel tractors do get through, needless to say, and at a great saving in time and money over previous methods. Special implements have been devised to perform the next step of deep tillage and for

The Diesel tractor and cane planter furrows and plants in one operation.

Two ton bundles of harvested cane are easily loaded by simply attaching a crane similar to the above to a Diesel tractor. Terrain makes little difference to such a versatile combination.

this the Diesel tractor has almost completely displaced the steam cable-drawn plow outfits which were considered absolutely necessary a few years ago.

After preparing the soil by deep plowing and harrowing, the Diesel is attached to a machine which creates a deep furrow and plants the cane in one operation.

During the harvest, rotary loading cranes are fitted to the tractors and this combination easily transfers bundles of cut cane weighing several tons each from the fields to cars on the narrow gauge portable railroad spurs. The trip to the permanent rail head is accomplished by the tractor turning locomotive and hauling the trains of loaded cars. Each car carries about five tons of cane. In some cases the empty cars must be taken up very steep grades for loading and then "slacked down" with the train pulling the tractor. Since no other machine has been satisfactory for this latter service it can be stated without fear of contradiction that the profitable tillage of much "upper land" is directly due to Diesel tractors.

In addition to the previously mentioned activities dealing specifically with the various phases of sugar plantations and cane planting and harvesting, the numerous Diesel tractors are continually kept busy during slack periods at countless incidental jobs of a general nature. Perhaps one of the most important of these is handling rock. Not only in clearing the fields to be tilled do the Diesels show their merit but, also, in preparing excavations where large boulders are frequent and stubborn problems. A "Cat" and bulldozer usually make short work of such obstacles. Once removed the rocks are in many cases crushed by means of Diesel generated power.

From the foregoing outline of tractor activities it must be evident that there are very few phases of sugar cane raising in Hawaii in which the Diesel does not figure prominently. In some cases, as has been stated, growing cane would be impossible without the Diesel tractor. In all cases, it is much more satisfactory and economical than with other types of power.

VERNON, TEXAS

Municipal Light and Water Plant

By ORVILLE ADAMS

THE city of Vernon, located on the main line of the Denver and Frisco, is the leading town between Wichita Falls and Amarillo, Texas, having doubled in population since 1920. Vernon has a number of interesting municipal features of which she has a right to be proud. Chief of them all, says Mayor H. D. Hockersmith, is the Diesel Light and Power plant. Indeed, it is an outstanding example of Diesel economy, and uninterrupted continuity of honest city administration and competent engineering operation. In Texas, it serves as a "yardstick" for measuring the possibilities of municipal operation of Diesel power plants, for its success has been so phenomenal that city officials from various parts of the state journey to Vernon to see and hear how a town of this size can buy a plant and earn profits from Diesel engine operation that campares favorably with that of cities three to five times larger.

Starting in 1923 with a total capacity of 300 hp., built at an initial cost of $45,000, the plant has grown consistently until now it has a total capacity of 2,700 hp., just nine times its original size, representing an actual investment of $450,000, no indebtedness and a good surplus, all of which has been paid out of net earnings of the plant, with the exception of the initial investment of $45,000. And in addition to all this, from an economy standpoint, Mayor Hockersmith said to this writer recently, "the plant has saved the people of Vernon more than $1,000,000 on account of the difference between the present rate and what they were paying when the plant was built," and he claims that Vernon has the lowest light rate of any city in Texas. In support of this claim, he cited the rate of eight cents for the first 30 kilowatts, and 3 cents for all current used over and above 30 kwh. with a sliding scale for large consumers. There is no question, he says, as to the popularity of the plant, the people who are its patrons are satisfied, and even those who for some unexplained reason have not seen fit to give it their support, recognize the fact that they are getting a direct reduction in rates on account of the Diesel plant.

Even this picture would be incomplete without some of the information found in the financial statement for 1937, a copy of which the mayor handed me. It shows that the Light Plant Profits increased from $17,912.55 in 1931 to $39,703.99, in 1936, based on a kilowatt output of 2,124,900 kwh. in 1931 which had increased to 3,522,900 kwh. in 1936. The gross collections for current in 1933 of $54,167.67 had grown to $72,896.46 for 1936. As might be expected, the total assessed valuation of taxable values decreased from $8,248,360.00 and a tax rate of $2.15 per 100 valuation, to $5,204,080.00 valuation for 1936 and a tax rate of $1.90, between 1929 and 1936. This resulted in a decrease of tax collection from $165,528.33 10 years ago paid by the citizens to $104,456.71, however, the total collections, which include taxes, and profits on the light and water plant, increased from $203,692.63 for 1931 to $224,411.80 for 1936. While tax collections fell off nearly one third, the total revenue taken in by the city increased more than 10 per cent during the ten-year period, which difference is due to the profits from the water and light plants, which combined, now amounts to more than $60,000 a year, and is a sum that is nearly 60 per cent of the amount of money collected in taxes, and 25 per cent of the total money collected from all sources.

It is easy to see why the city of Vernon has never defaulted on any of its obligations, and is able to buy new engines as needed out of revenue profits.

The load on the Vernon plant has practically doubled since 1928, at which time the city purchased a 500 hp. 4-cylinder, 340 kw. 225 rpm. Fulton Air Injection Diesel. The output of the plant that year was 2,224,200 kwh. In 1933 a second Fulton Air Injection Diesel engine, a 5-cylinder, 625 hp. 432 kw. 225 rpm. was purchased to handle the increased load which totalled more than 3,000,000 kwh. in 1934. At the close of 1935, another Fulton Diesel rated at 625 hp., a duplicate of the second engine was placed in operation to handle a load that had grown to 3,522,900 kwh. in 1936. The load on the plant continues to grow at the rate of around 500,000 kwh. per year. As

General engine room view showing the three Fulton Diesels at the Vernon, Texas, municipal electric plant.

Switchboard and distribution panel. At the extreme left is the De Laval lubricating oil purifier.

a result, plans are being made to purchase another engine during the present year, and retire from service one or two of the three old two cycle solid injections which have seen twelve to fifteen years service and are now too small for the purpose. The reason for this is plain to be seen. In a typical month recently, it was necessary to operate one engine 554 hours, the second engine 538 hours, and the third engine 266 hours during the month, while one of the small two cycle units were operated a total of 150 hours. During the same month, the total production was 376,800 kwh., averaging 12,152 kwh. per day.

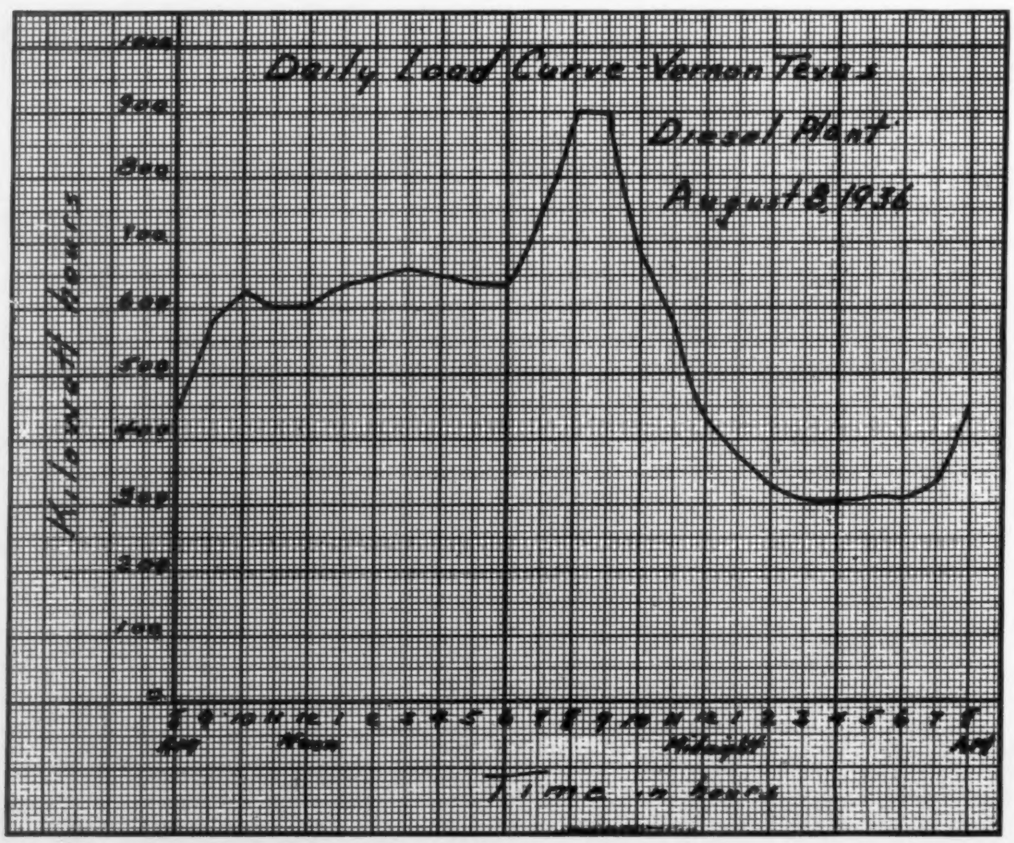
Fuel Economy Satisfactory: The fuel economy of the Vernon plant has been very satisfactory. The Chief Engineer, W. T. Elliott, under whose direction the power plant is operated, gave the writer data on the fuel consumption for 20 days during December, 1937, which showed that Engine No. 1 generated 107,600 kwh. on 8,960 gallons of fuel, or 12 kwh. per gallon, Engine No. 2, 39,500 kwh. on 3,185 gallons of fuel, or 12.40 kwh. and engine No. 3 generated 62,700 kwh. on 5,355 gallons of fuel, or 11.75 kwh. per gallon.

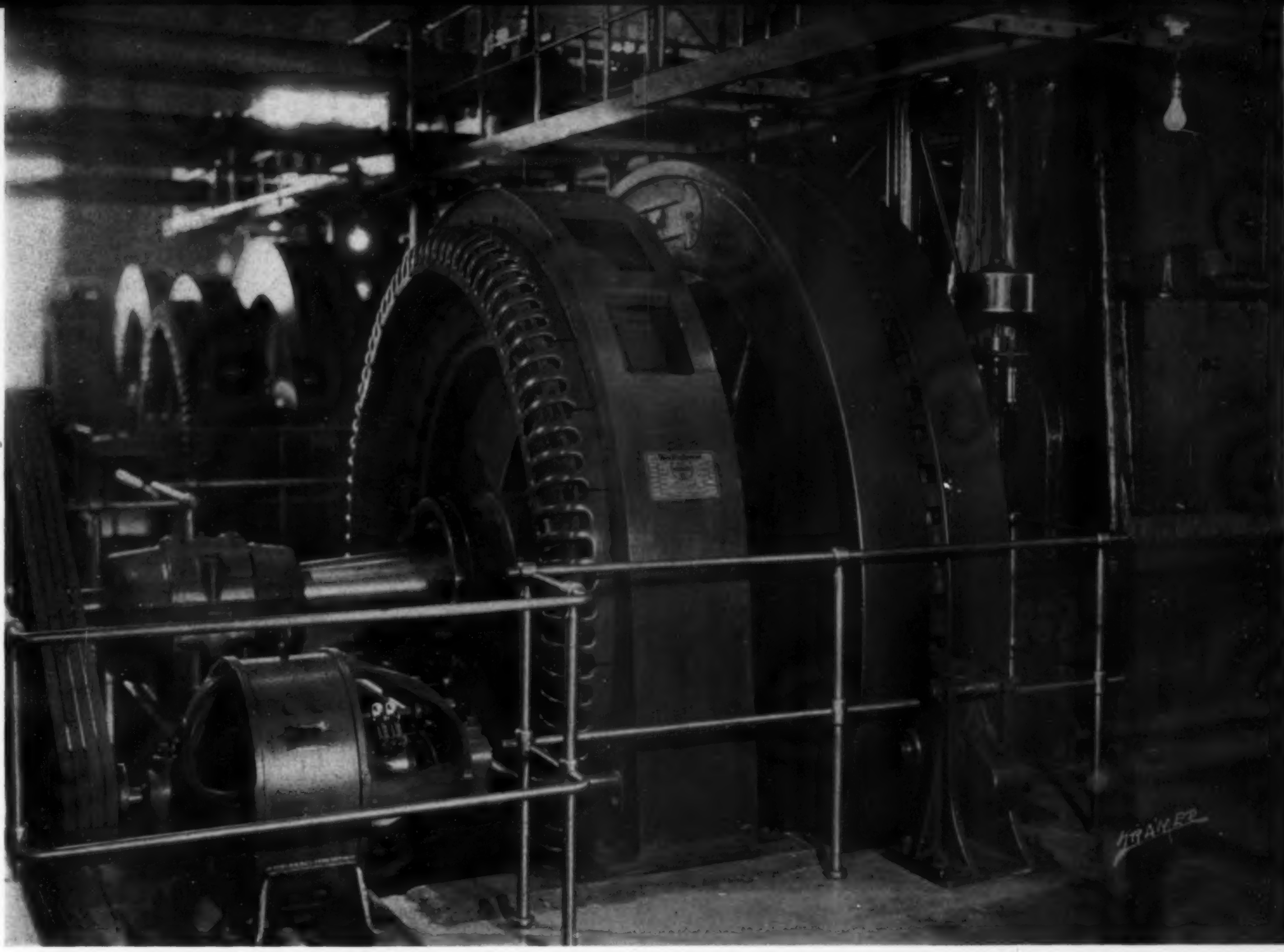
The lubrication oil consumption for 1936 averaged 5,146 hp. hrs. per gallon.

In its new building, built a few years ago at a cost of $35,000, the plant presents a model appearance, the various engine units being systematically arranged, with floor space available for a 750 to 1,000 hp. engine which will be added sometime this year, and one of three small units will be removed from its foundation.

The room, the engines and necessary adjuncts and auxiliaries are modern and are operated in an efficient manner. The intake air is filtered through batteries of American Air Filters, housed from the weather and windblown sand. The lubricating of the plant is reclaimed by means of a De Laval centrifugal purifier, and a Cuno edge type filter is likewise used on the supply pipe. The fuel oil is passed through Nugent filters. The oil is also cooled with S & K oil coolers on each engine. A Permutit Zeolite water filter is used in the plant. Two of the alternators are Westinghouse and one a General Electric. Brown pyrometers are used on three Fulton engines and an Alnor on one small engine. Dayton Dowd pumps and G.E. motors are used on the cooling system, pumping water to spray pond where Binks nozzles atomize the water over towers. A series of Viking Pumps are used in connection with fuel storage, transfer and day tank supply systems. A Maihak indicator is used by the engineer to take cards and keep a regular balance on the engine combustion behavior. The building is a brick and concrete structure, well lighted and ventilated, with office and switchboard compartments, locker rooms for the operating crew, machine shop, lubricating oil and supply storage.

Ten years ago, Mayor Hockersmith made the following statement for publication: "While the Vernon municipal plant dates back only to 1922, its history goes back further than that, when, dissatisfied with the rates being charged by the company holding the franchise at that time, and not satisfied with the service given, the voters decided to issue bonds for installation of a plant of their own. The issuance of the bonds was enjoined, but even that failed to stop the movement toward a municipal Diesel plant. Determined to operate their own municipal plant, the officials then searched through their vaults and found $25,000 in old waterworks bonds that had never been sold, which they traded in on a plant at their par value and issued $20,000 in revenue warrants to finance the construction of the plant. The plant started operations in late 1922, and has been operating since. To begin with the plant consisted of one 200 hp. and one 100 hp. engines. As the demand for current increased, additional engines were installed, until 1928





Close-up of Westinghouse generator and v-belt driven exciter. The Vernon plant has two Westinghouse units and one General Electric.

when the first large air injection engine went into the plant. When the municipal plant was put in operation that year, the rate for current in Vernon was 15 cents per kwh. The municipal plant began with a rate of 10 cents per kwh. The old company cut their rate to 5 cents, which rate they maintained for more than a year. On the day that they made this cut, we got thirty of their customers and lost none. However, the municipal plant gained customers constantly and the plant grew much more rapidly than the population. When the plant started, the population was between 5,000 and 6,000, and at the present time, it has passed 10,000."

It can be seen that the people are paying their city approximately $7.00 per capita for electric light and power, and their city is returning back to them approximately $4.00 per capita in the form of net profit annually. This unusual record is made in the face of the fact of competition by the West Texas Utilities Company, that operates in the town, holding a franchise that was originally held by an independent plant, which has changed hands several times since the municipal plant was established.

A considerable savings not shown to account is for the current used by the water works and street lights, the city hall and other city buildings. A due share of the credit for successful operation goes to Mr. W. T. Elliott, who has been chief engineer since the plant was built, and to Mayor Hockersmith, who is also superintendent of the light and water plant. The mayor is holding his job longer than any other Mayor in the state, and his experience goes back to 1902 when he installed and owned the first light plant in Vernon. Obviously, his interest and attention to the successful administration of the municipal utilities of his city is appreciated by the citizens who continue to draft him for the job.

Very complete and accurate records of the operation of the plant have been kept by Mr. Elliott, whose corps of operating men maintain the plant and equipment at a high standard of operating efficiency.

Another very important link in the chain of successful operation of the plant is the thoroughly competent city electrician, Mr. S. I. Vaughn commonly known as "Sid." He preaches from one text only, and that is "Service," and with the aid of his competent crew of linemen, it's service he gives. His motto is "all lights functioning twenty-four hours a day, and three hundred and sixty-five days a year." His office is equipped with all the necessary instruments to enable him to accomplish his purpose, including portable voltmeters, recording voltmeters, pole jacks, etc. The words "Interruption of service" are not in his vocabulary.

The city of Vernon operates under a special charter, and is known in Texas as a "Home Rule" city. The only elective officers are a Mayor, and four Commissioners. The four holding the office of Commissioner at present are R. J. Byars, W. W. Jones, H. C. Thompson and J. V. Owen all of whom are in hearty accord with the present and the past policies of the operation of the plant.

Officials of cities ranging from 6,000 to 10,000 population were and are frequently discouraged when they advance the idea of a municipal plant. It is no cinch to design and operate a satisfactory plant for a consumption no larger than provided in a town of this size, yet the city of Vernon has demonstrated throughout fifteen years of steady growth, during which time it has always been able to buy new equipment, replace obsolete machines and make a profit, success with such an undertaking. Its water works plant earns a net profit of around $25,000 a year, and is one of the best and most efficient to be found in towns of this size. The city has had a balance between $75,000 and $100,000 and works on a policy of pay as you go, the light and water works always having a large balance on hand.

$3.00

DIESEL ENGINES DESCRIBED

- Alco—Locomotive type
- Alco—17½"x25" Four cycle
- Alco—Sulzer, Two cycle
- Allis-Chalmers
- Atlas Imperial—all types
- Buckeye Machine Co.
- Buda—all types
- Caterpillar—all types
- Chicago Pneumatic—two types
- Coatalen—Aviation
- Cooper-Bessemer—four types
- Cummins—all types
- Deschamps—Aviation
- DeLaVergne—all types
- Enterprise Engine
- Fairbanks-Morse—five types
- Guiberson—Aviation
- Hall Scott
- Hercules—all types
- Hill Diesel
- Hooven, Owens, Rentschler
- Ingersoll Rand—Type "S"
- International Harvester Co.
- Junkers—Aviation
- Lister Diesel
- Lorimer Diesel
- Mercedes-Benz—Aviation
- Murphy Diesel
- Standard Diesel
- Stover Diesel
- Superior—Type "A"
- Superior—Type "S"
- Ruston Diesel
- Victor—Vertical
- Victor—Horizontal
- Waukesha-Hesselman
- Weber—Vertical
- Weber—Horizontal
- Western Diesel
- Winton—Two cycle

Fifty-seven different models described and illustrated in color and full section.

FIFTY-SEVEN DIESEL ENGINES

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320 Pages—10¼"x13½"—610 Illustrations, $3.00

THIS new book on Diesel engines is entirely different from any other book previously published on the subject. In this new book fifty-seven Diesel engines are described in detail, illustrated in color and in full section.

John W. Anderson, author of the well-known book "Diesel Engines;" editor of "Diesel Application Planbook, Vol. One" and contributing editor to DIESEL PROGRESS, one of the most experienced and best known engineers in the Diesel industry, has described in intimate detail these fifty-seven Diesel engines. In this book he goes into the matter of individual design, discusses the features of design of each engine in clear cut, thoroughly understandable manner and makes it possible for the reader to grasp readily and quickly the differences between the various makes and types of engines now available on the market. He makes it possible to select from these fifty-seven different models the one engine fitted to the job in mind.

Beautifully illustrated in color, with sectional drawings visualizing with complete clarity the design features of each engine, this new book brings you under one cover a marvellously clear picture of the engines now available. Right up to the minute, as modern as tomorrow, printed on a big page size (10¼" x 13½") to make the illustrations readable, this new book is indispensable to the Consulting Engineer, Diesel Salesman, prospective Diesel engine buyer—yet the price is but $3.00 postpaid.

In addition to the section of this new book devoted to engine descriptions, nearly 150 pages of additional material of vital interest to you will be found immediately following the engine articles — see chapter headings hereunder. Your particular attention is drawn to the "Birth of the Diesel Engine" chapter because here you will find how the Diesel engine started, who was Dr. Diesel, what happened to him —original data never previously published on his early trials and tribulations—an intensely interesting chapter.

The blueprint section of the book, following the style set by volume one of the DIESEL APPLICATION PLANBOOK last year, will be found worth the price of the book. Eighty odd pages of new plans, new applications, bringing you up-to-date with what has happened during the past year in applying Diesel engines to varying power problems.

We offer you this new book believing it to be the finest book of its type ever produced, authoritative, informative, beautifully printed and bound—a book you will be proud to own, a book from which you will obtain much useful information. May we hope you will use the coupon hereunder to-day—now.

ADDITIONAL CHAPTER HEADINGS

(1) The Birth of the Diesel Engine
(2) Vibration Elimination
(3) Noise Elimination
(4) Flexible Connections
(5) Air Filtration
(6) Ponca City, Okla.
(7) Department Store Application Study
(8) Port Clinton, Ohio
(9) Sailors Snug Harbor
(10) Chicago Diesel Fire Boat
(11) 580 Fifth Ave., New York
(12) Mobile Ice Plant
(13) New York University
(14) Parke Davis Company
(15) Imperial Irrigation District
(16) LaPorte City, Iowa
(17) 8000 kw. Shanghai Plant
(18) 15,000 kw. Hydro Standby plant
(19) 22,000 hp. Mine installation
(20) Combination Hydro-Diesel-Steam
(21) French Community installation
(22) Paris, Texas, Observatory
(23) Langbein Cutlery Company
(24) U.S. Coast Guard vessel

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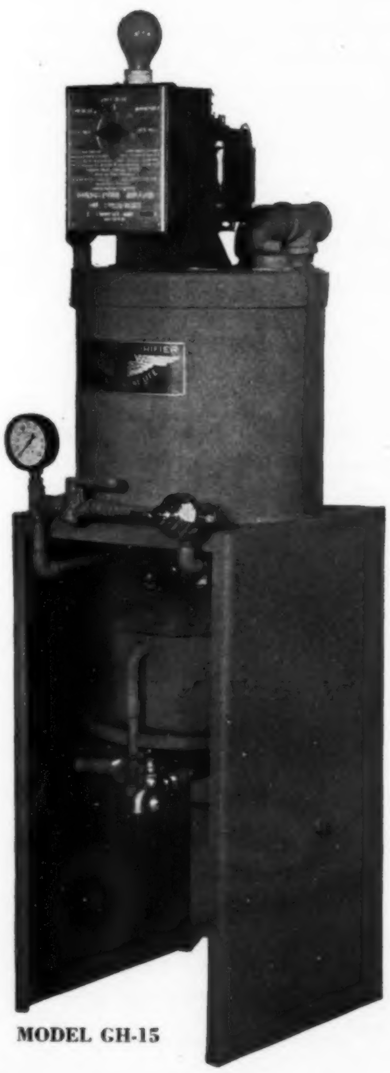
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NEW MARINE BULLETIN BY THE KORFUND COMPANY

THE Korfund Company announces publication of a new Marine Bulletin containing much information that never before has appeared in print and shows for the first time a typical ararngement of isolation of a main propulsion Diesel Engine. Other applications include isolations of main engines, isolation of auxiliary Diesels and all types of marine machinery. The booklet also includes complete technical data on Korfund Vibro-Dampers and Korfund Type "T" Seismo Dampers. Complimentary copies are available by writing to the Korfund Company, 48-26 Thirty-second Place, Long Island City.

This organization, long known in the Diesel field as manufacturers of anti-vibration products, has turned to marine Diesel installations and has recently developed many new products and arrangements for the prevention of vibration transmission of Diesel engines on board ships. All of this information, together with technical drawings, charts, and data sheets, is found in the new bulletin recently published by The Korfund Company entitled "Smoother Sailing with Korfund." It will prove of value to Marine Engineers, Naval Architects, and owners, and operators of Diesel vessels.

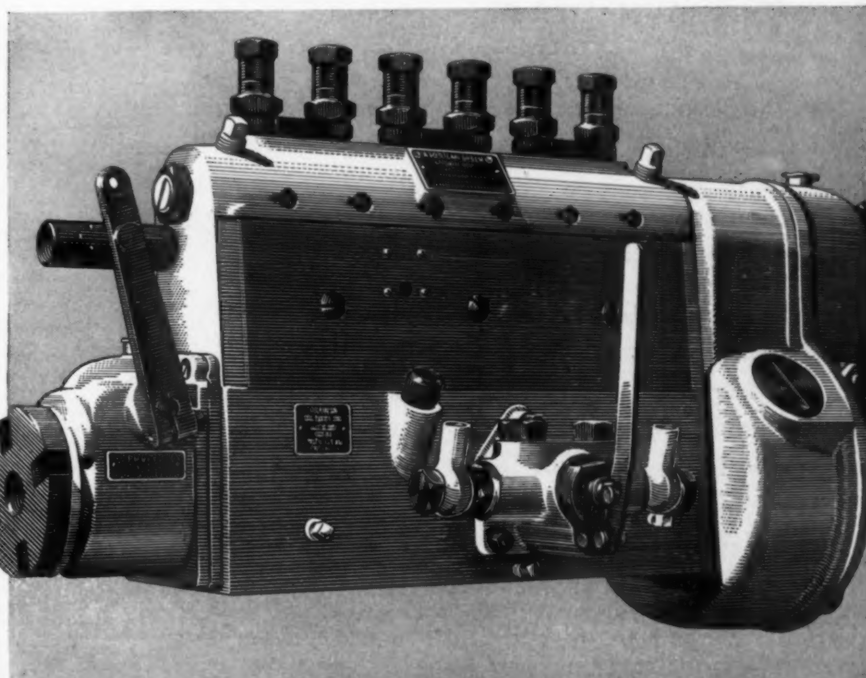
NEW DIESEL YACHT IN NORTHWEST WATERS

JACK KUPHAL of Bremerton, Wash., is the proud owner of the Diesel express cruiser *Aimee-K*. The cruiser is the joint creation of W. J. Schertzer and the Grandy Boat Co., well-known Seattle boat builders. In her 45-foot length are two complete staterooms and a large pilot house. Toilet and galley facilities fitting to a well-planned cruiser are in the after trunk. Power for this new boat is a 140 hp. Cummins Diesel. This particular engine is extensively chrome plated as it was one of the Cummins "show engines" at last year's National Motor Boat Show. This engine operates at 1,000 rpm., at which speed in excess of 16 miles per hour is logged by the *Aimee-K*. Five gallons of fuel per hour is the modest consumption.

Kuphal flies the burgee of the Bremerton Yacht Club and has already covered many hundreds of miles of scenic northwest waters in his boat. He has expressed entire satisfaction in the operation of the Cummins Diesel, and particularly takes pride in its economy and total elimination of fire hazard.

TOM DRENNEN WINS PRESIDENT'S CUP

ONE of the most popular men in the whole Diesel industry, certainly that part of it on the Atlantic seaboard, is T. W. Drennen, general manager of the New York Fairbanks-Morse branch. On January 21 Col. R. H. Morse presented the President's Cup to Tom Drennen as head of the branch selling the greatest percentage of its quota. Tom won this same cup back in 1934, too — so congratulations to him and his crew. Tom is the big fellow with the white handkerchief in the picture taking the cup from his worthy boss, the Colonel.



S. A. E. NEWS

SOMETHING is finally being done about the troublesome lack of standardization of voltages in the electrical systems of Diesel-powered vehicles. At a general conference of representatives of battery, electric equipment, truck, and lamp manufacturers held on Jan. 14, at the SAE 1938 Annual Meeting in Detroit, three decisions were made: to restrict considerations to automotive and small industrial Diesels of the mobile type; to adopt tentative standard voltages of 12 and 24; and to recommend that a representative subdivision of the Electric Equipment Division of the SAE Standards Committee be appointed to develop a definite SAE Standard for these systems.

Sharp debates on the respective merits of two-cycle versus four-cycle Diesels, on the comparative fire hazard of gasoline and Diesel aircraft fuels, and on different effects of Diesel supercharging, followed the reading of four Diesel papers at the 1938 SAE Annual Meeting held in January in Detroit.

"When it is considered that Diesel aircraft engines are operating today at specific fuel consumptions as low as 0.36 lb. per bhp.-hr., and that a 2,000-hp. design is now being developed that will weigh less than 1 lb. per hp., even the most skeptical must concede the advantages of Diesel engines for aircraft," contended E. G. Whitney and H. H. Foster of the N.A.C.A. in the first paper.

The contention that a time will come when we will no more fly in a plane filled with gasoline than in an airship filled with hydrogen, was challenged by another discusser who maintained that future high-output Diesel aircraft engines may require a fuel that is just as volatile as gasoline.

"The four-stroke cycle is more reliable at high speeds" — "the pistons get a breathing spell in which they can cool" . . . . "the two-stroke cycle gives greater power per unit weight" . . . . "the barrel-type engine is especially adapted to two-cycle Diesels" . . . . "the ideal two-cycle Diesel should have no exhaust valves, with opposed-piston and sleeve-valve types of scavenging preferred" . . . . are excerpts of the four-cycle versus two-cycle arguments held at the SAE Annual Meeting.

That Diesel cylinder pressures can be increased 50 per cent by supercharging without major design changes, that supercharging decreases the ignition lag at a given compression ratio and, hence, fuels of inferior ignition quality can be used, and that supercharging acts to soften or even to eliminate combustion shock, were among the claims advanced during a spirited discussion of Diesel supercharging.

That operating automotive Diesel engines at lower speeds than that at which they are designed to run is the cause of many serious troubles such as incomplete combustion, excessive cylinder wear, bearing failures, carbon and sludge deposits, and loss of power, is the contention of John Bennett of the Cummins Engine Co., according to the paper on Diesel Maintenance that he presented at the December meeting of the Oregon Section of the SAE in Portland, Ore.

Carl Behn, genial sales manager for the Superior engine division of the National Supply Company, is Vice President of Diesel Activity for the SAE this year.

IMPORTANT NOTICE TO EXPORTERS

ALL exporters of automotive products, in order to avoid difficulty in clearing their shipments to foreign countries after January 1, 1938, should immediately secure a copy of the revised edition of Schedule B, the Statistical Classification of Domestic Commodities Exported from the United States.

This is most essential inasmuch as exporters are required to furnish on their export declarations submitted to the Collectors of Customs the detailed commodity descriptions which appear in Schedule B, and Collectors of Customs have been instructed to refuse to accept documents which have not been properly prepared in accordance with Schedule B.

Exporters are not required to insert on declarations the statistical code numbers of the Department of Commerce which are shown in Schedule B. However, the use of these code numbers greatly facilitates the work of clearing shipments and compiling the statistics. More important to exporters — the use of the commodity code numbers in addition to the commodity description aids in the work of proper classification and thus improves the accuracy and utility of the figures. The Department of Commerce, therefore, strongly urges that these classification numbers also be inserted by the exporters.

Copies of Schedule B may be secured from the Superintendent of Documents, Washington, D. C., and District Offices of the Department of Commerce. Price 30 cents.

DIESEL efficiency and economy in short-haul rail freight service has been shown by the operating record of a Hercules Diesel engine recently installed in a rail car for the Pacific & Great Eastern Railway of Canada.

Now making daily runs between Lillooet and Bridge River, B. C., the Hercules Diesel was installed by Western Bridge Company, Vancouver, B. C., to replace a gasoline engine. The car, weighing approximately 38 tons, regularly hauls four loaded flat cars carrying a total weight of 85 tons with no trouble in maintaining its time schedule over a 62-mile curving track.

Remarkable economy has resulted from the installation, according to Western Bridge Company officials. The rail car now travels 6.6 miles per gallon of fuel oil as compared with 2.6 miles per gallon of gasoline with the previous installation. When the car was delivered from the Western Bridge Company's shops at Vancouver to Lillooet, a distance of 120 miles, the scheduled running time for steam passenger trains over the track was reduced by a safe margin. Although the route contains grades as great as 2.2 per cent, fuel consumption for the initial run was only 16 gallons.

INCREASE IN MOTORSHIP TONNAGE

DURING the period 1927 to 1937 oil-engined tonnage throughout the world has increased by over 10,000,000 tons gross, whilst, according to *The British Motor Ship*, steamers have diminished by 8,000,000 tons gross. Within the past year motor ships of nearly 1,500,000 tons gross have been added to the world's mercantile fleet, and there has been a diminution in steamers of nearly 200,000 gross tons. The Hamburg-American Line has the biggest motor fleet with 38 ships of 257,000 tons gross, followed by the Norwegian shipowner Wilh. Wilhelmsen with 236,000 tons gross. These figures exclude tankers, of which the Anglo-Saxon Petroleum Co. owns a fleet of about 300,000 tons gross.

NEW MOBILE DIESEL COMPRESSOR

FAIRBANKS, MORSE & CO. has announced a new self-contained, Diesel-powered, 210-cfm. air compressor, available with several types of portable and semi-portable mountings, for a wide range of service applications. This new compressor combines the economy and dependability of the Fairbanks-Morse Model 36-A Diesel (*Diesel Engine Catalog*, page 105) with the superior design features of a proved air compressor, making available a compact, lightweight unit that offers maximum efficiency and absolute reliability under all working conditions.

Through the proper application of modern principles of enginering design, the compressor unit has been kept light in weight and small in size, contributing to its portability. Ample bearing surfaces and proper lubrication make possible a long trouble-free life. The water cooling system assures thorough and uniform cooling in any climate and under any condition. Low upkeep expense results from the employment of refinements of proved automotive engine design.

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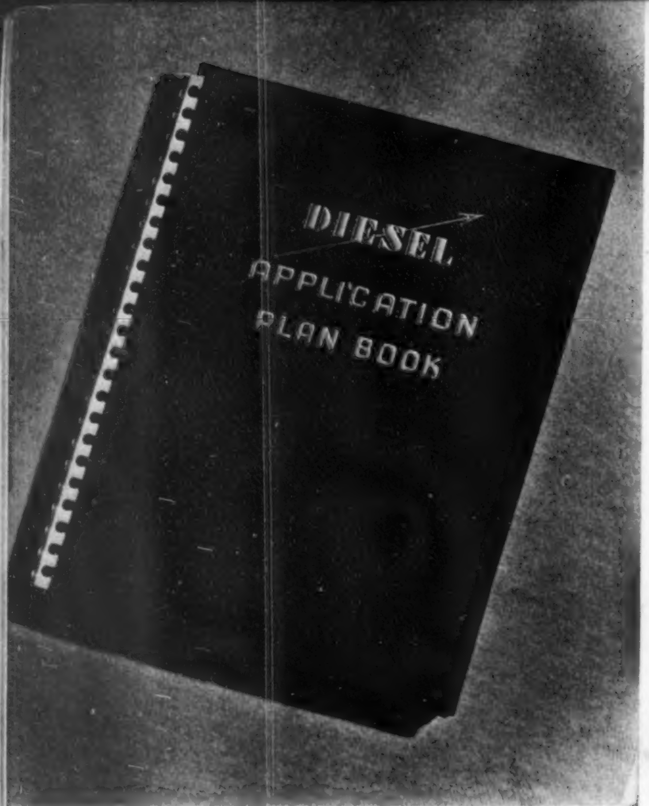

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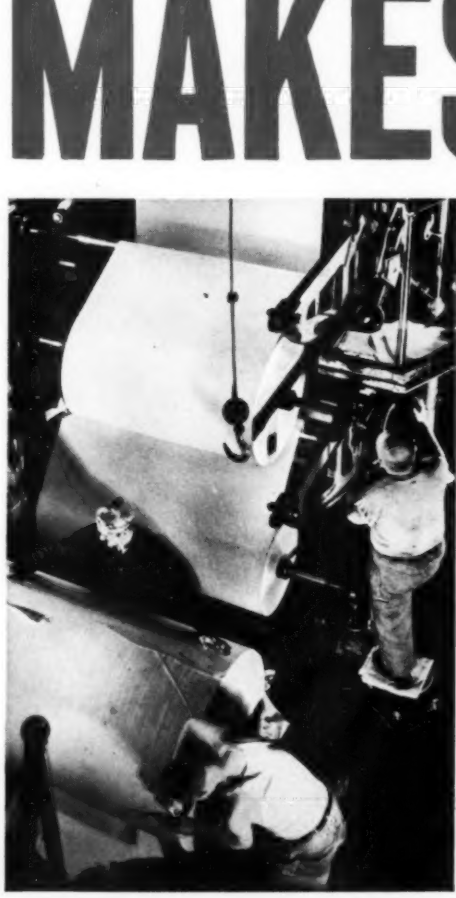

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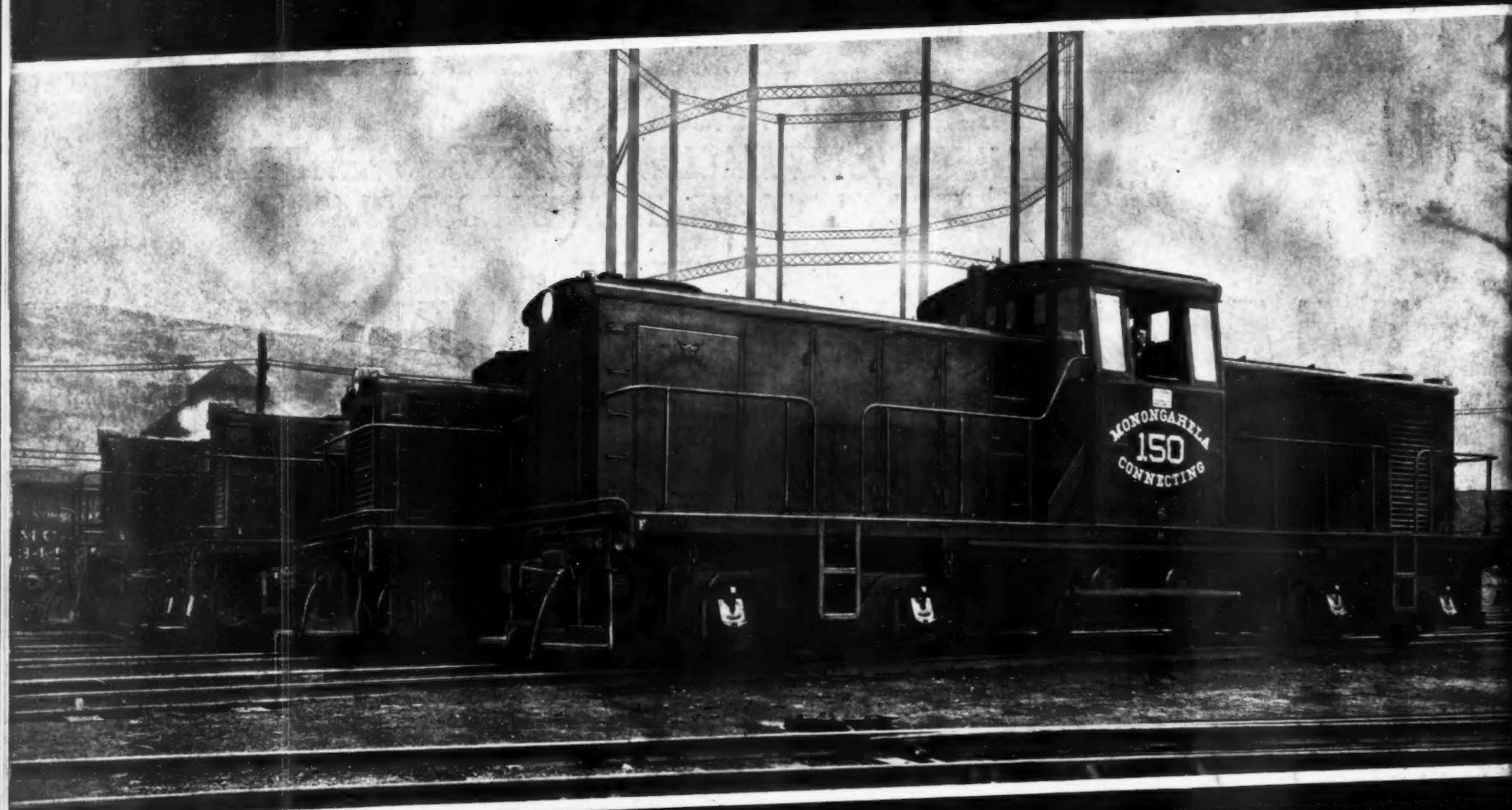

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